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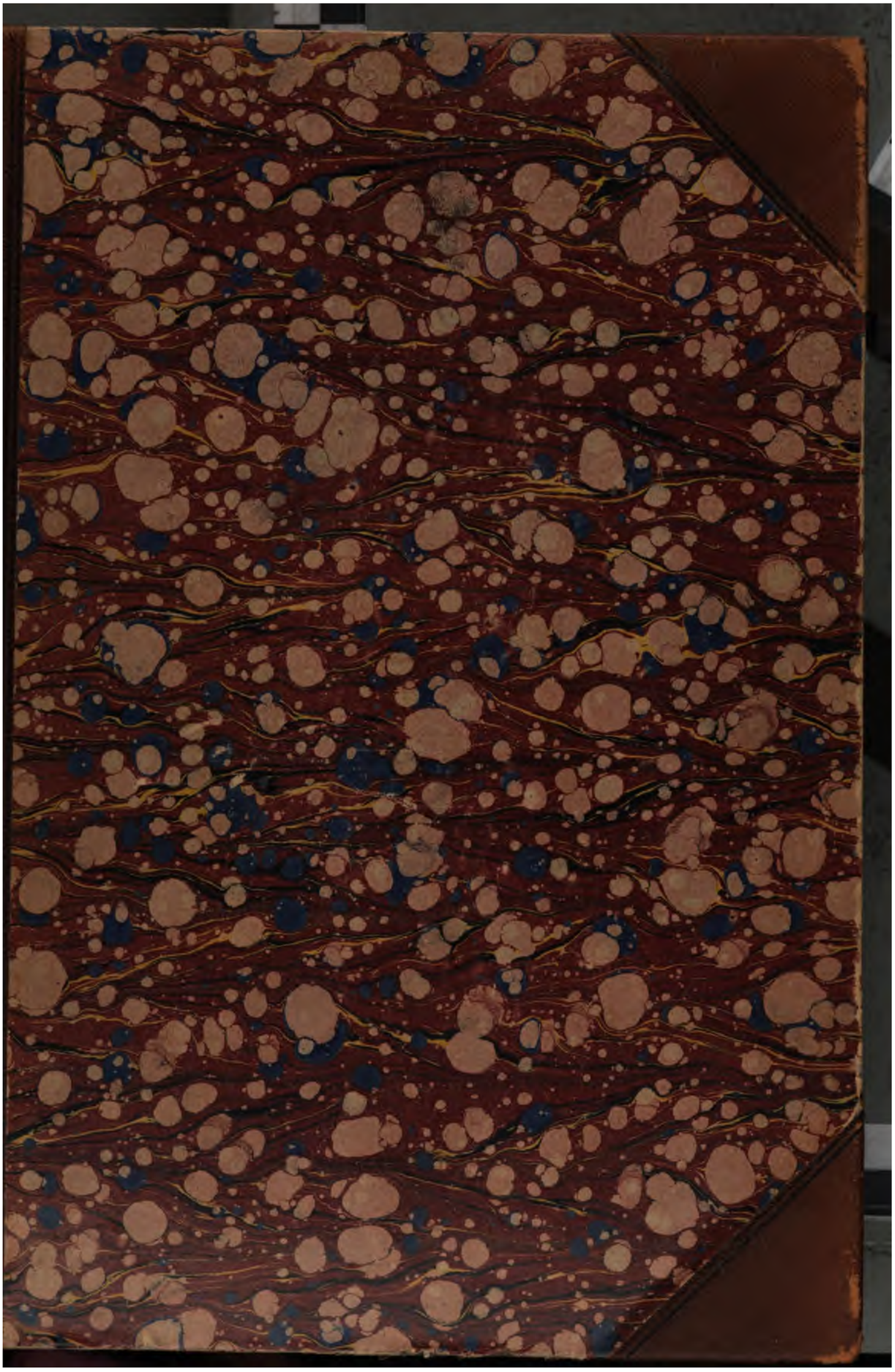

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II. A CLASSIFIED LIST OF THE MONOGRAPHS COMPLETED, IN COURSE OF PUBLICATION, AND IN PREPARATION, WITH THE NAMES OF THEIR RESPECTIVE AUTHORS;

III. THE DATES OF ISSUE OF THE ANNUAL VOLUMES;

IV. A GENERAL SUMMARY, SHOWING THE NUMBER OF THE PAGES, PLATES, FIGURES, AND SPECIES IN EACH MONOGRAPH;

V. A STRATIGRAPHICAL LIST OF THE BRITISH FOSSILS FIGURED AND DESCRIBED IN THE YEARLY VOLUMES.

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THE PALÆONTOGRAPHICAL SOCIETY:

Showing the ORDER *of publication; the* YEARS *during which the Society has been in operation; and the* CONTENTS *of each yearly Volume.*

Vol. I. Issued for the Year	1847	The Crag Mollusca, Part I, Univalves, by Mr. S. V. Wood, 21 plates.
„ II. „	1848	The Reptilia of the London Clay, Vol. I, Part I, Chelonia, &c., by Profs. Owen and Bell, 38 plates. The Eocene Mollusca, Part I, Cephalopoda, by Mr. F. E. Edwards, 9 plates.
„ III.* „	1849	The Entomostraca of the Cretaceous Formations, by Mr. T. R. Jones, 7 plates. The Permian Fossils, by Prof. Wm. King, 29 plates. The Reptilia of the London Clay, Vol. I, Part II, Crocodilia and Ophidia, &c., by Prof. Owen, 18 plates. The Fossil Corals, Part I, Crag, London Clay, Cretaceous, by Messrs. Milne Edwards and Jules Haime, 11 plates.
„ IV. „	1850	The Crag Mollusca, Part II, No. 1, by Mr. S. V. Wood, 12 plates. The Mollusca of the Great Oolite, Part I, Univalves, by Messrs. Morris and Lycett, 15 plates. The Fossil Brachiopoda, Vol. I, Part III, No. 1, Oolitic and Liassic, by Mr. Davidson, 13 plates.
„ V. „	1851	The Reptilia of the Cretaceous Formations, by Prof. Owen, 39 plates. The Fossil Corals, Part II, Oolitic, by Messrs. Milne Edwards and Jules Haime, 19 plates. The Fossil Lepadidæ, by Mr. Charles Darwin, 5 plates.
„ VI. „	1852	The Fossil Corals, Part III, Permian and Mountain-limestone, by Messrs. Milne Edwards and Jules Haime, 16 plates. The Fossil Brachiopoda, Vol. I, Part I, Tertiary, by Mr. Davidson, 2 plates. The Fossil Brachiopoda, Vol. I, Part II, No. 1, Cretaceous, by Mr. Davidson, 5 plates. The Fossil Brachiopoda, Vol. I, Part III, No. 2, Oolitic, by Mr. Davidson, 5 plates. The Eocene Mollusca, Part II, Pulmonata, by Mr. F. E. Edwards, 6 plates. The Radiaria of the Crag, London Clay, &c., by Prof. E. Forbes, 4 plates.
„ VII. „	1853	The Fossil Corals, Part IV, Devonian, by Messrs. Milne Edwards and Jules Haime, 10 plates. The Fossil Brachiopoda, Introduction to Vol. I, by Mr. Davidson, 9 plates. The Mollusca of the Chalk, Part I, Cephalopoda, by Mr. D. Sharpe, 10 plates. The Mollusca of the Great Oolite, Part II, Bivalves, by Messrs. Morris and Lycett, 8 plates. The Mollusca of the Crag, Part II, No. 2, Bivalves, by Mr. S. V. Wood, 8 plates. The Reptilia of the Wealden Formations, Part I, Chelonia, by Prof. Owen, 9 plates.
„ VIII.† „	1854	The Fossil Brachiopoda, Vol. I, Part II, No. 2, Cretaceous, with Appendix and Index to Vol. I, by Mr. Davidson, 8 plates. The Reptilia of the Wealden Formations, Part II, Dinosauria, by Prof. Owen, 20 plates. The Mollusca of the Great Oolite, Part III, Bivalves, by Messrs. Morris and Lycett, 7 plates. The Fossil Corals, Part V, Silurian, by Messrs. Milne Edwards and Jules Haime, 16 plates. The Fossil Balanidæ and Verrucidæ, by Mr. Charles Darwin, 2 plates. The Mollusca of the Chalk, Part II, Cephalopoda, by Mr. D. Sharpe, 6 plates. The Eocene Mollusca, Part III, No. 1, Prosobranchiata, by Mr. F. E. Edwards, 8 plates.

* The Volume for the year 1849 consists of two separate portions, each of which is stitched in a paper cover, on which are printed the dates 1848, 1849, and 1850. The one portion contains 'Cretaceous Entomostraca' and 'Permian Fossils;' the other, 'London Clay Reptilia,' Part II, and 'Fossil Corals,' Part I.

† This Vol. is marked on the outside 1855.

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Vol. IX.*	Issued for the Year 1855	The Mollusca of the Crag, Part II, No. 3, Bivalves, by Mr. S. V. Wood, 11 plates. The Reptilia of the Wealden Formations, Part III, by Prof. Owen, 12 plates. The Eocene Mollusca, Part III, No. 2, Prosobranchiata, continued, by Mr. F. E. Edwards, 4 plates. The Mollusca of the Chalk, Part III, Cephalopoda, by Mr. D. Sharpe, 11 plates. The Tertiary Entomostraca, by Mr. T. R. Jones, 6 plates. The Fossil Echinodermata, Oolitic, Vol. I, Part I, by Dr. Wright, 10 plates.
„ X.	„ 1856	The Fossil Echinodermata, Oolitic, Vol. I, Part II, by Dr. Wright, 12 plates. The Fossil Crustacea, Part I, London Clay, by Prof. Bell, 11 plates. The Fossil Brachiopoda, Vol. II, Part IV, Permian, by Mr. Davidson, 4 plates. The Fossil Brachiopoda, Vol. II, Part V, No. 1, Carboniferous, by Mr. Davidson, 8 plates. The Reptilia of the Wealden Formations, Part IV (Supplement No. 1), by Prof. Owen. 11 plates. The Reptilia of the London Clay, Vol. I (Supplement), by Prof. Owen, 2 plates.
„ XI.	„ 1857	The Fossil Echinodermata, Oolitic, Vol. I, Part III, by Dr. Wright, 14 plates. The Fossil Brachiopoda, Vol. II, Part V, No. 2, Carboniferous, by Mr. Davidson, 8 plates. The Reptilia of the Cretaceous Formations (Supplement No. 1), by Prof. Owen, 4 plates. The Reptilia of the Wealden Formations (Supplement No. 2), by Prof. Owen, 8 plates. The Polyzoa of the Crag, by Prof. Busk, 22 plates.
„ XII.	„ 1858	The Fossil Echinodermata, Oolitic, Vol. I, Part IV, by Dr. Wright, 7 plates. The Eocene Mollusca, Part III, No. 3, Prosobranchiata continued, by Mr. F. E. Edwards, 6 plates. The Reptilia of the Cretaceous Formations (Supplements No. 2, No. 3), by Prof. Owen, 7 plates. The Reptilia of the Purbeck Limestones, by Prof. Owen, 1 plate. The Fossil Brachiopoda, Vol. II, Part V, No. 3, Carboniferous, by Mr. Davidson, 10 plates.
„ XIII.	„ 1859	The Fossil Brachiopoda, Part V, No. 4, Carboniferous, by Mr. Davidson, 20 plates. The Reptilia of the Oolitic Formations, No. 1, Lower Lias, by Prof. Owen, 6 plates. The Reptilia of the Kimmeridge Clay, No. 1, by Prof. Owen, 1 plate. The Eocene Mollusca, Part IV, No. 1, Bivalves, by Mr. S. V. Wood, 13 plates.
„ XIV.	„ 1860	The Fossil Brachiopoda, Vol. II, Part V, No. 5, Carboniferous, by Mr. Davidson, 8 plates. The Reptilia of the Oolitic Formations, No. 2, Lower Lias, by Prof. Owen, 11 plates. The Reptilia of the Kimmeridge Clay, No. 2, by Prof. Owen, 1 plate. The Fossil Estheriæ, by Prof. Rupert Jones, 5 plates. The Fossil Crustacea, Part II, Gault and Greensand, by Prof. Bell, 11 plates.
„ XV.	„ 1861	The Fossil Echinodermata, Oolitic, Vol. II, Part I (Asteroidea), by Dr. Wright, 13 plates. Supplement to the Great Oolite Mollusca, by Dr. Lycett, 15 plates.
„ XVI.	„ 1862	The Fossil Echinodermata, Cretaceous, Vol. I, Part I, by Dr. Wright, 11 plates. The Trilobites of the Silurian, Devonian, &c., Formations, Part I (Devonian and Silurian), by Mr. J. W. Salter, 6 plates. The Fossil Brachiopoda, Vol. III, Part VI, No. 1, Devonian, by Mr. Davidson, 9 plates. The Eocene Mollusca, Part IV, No. 2, Bivalves, by Mr. S. V. Wood, 7 plates. The Reptilia of the Cretaceous and Wealden Formations (Supplements), by Prof. Owen, 10 plates.
„ XVII.	„ 1863	The Trilobites of the Silurian, Devonian, &c., Formations, Part II, by Mr. J. W. Salter, 8 plates. The Fossil Brachiopoda, Vol. III, Part VI, No. 2, Devonian, by Mr. Davidson, 11 plates. The Belemnitidæ, Part I, Introduction, by Prof. Phillips. The Reptilia of the Liassic Formations, Part I, by Prof. Owen, 16 plates.
„ XVIII.	„ 1864	The Fossil Echinodermata, Oolitic, Vol. II, Part II (Liassic Ophiuroidea), by Dr. Wright, 6 plates. The Trilobites of the Silurian, Devonian, &c., Formations, Part III, by Mr. J. W. Salter, 11 plates. The Belemnitidæ, Part II, Liassic Belemnites, by Prof. Phillips, 7 plates. The Pleistocene Mammalia, Part I, Introduction, Felis spelæa, by Messrs. W. Boyd Dawkins and W. A. Sanford, 5 plates. Title-pages, &c., to the Monographs on the Reptilia of the London Clay, Cretaceous, and Wealden Formations.

* This Vol. is marked on the outside 1856.

CATALOGUE OF WORKS—Continued.

Vol. XIX.*	Issued for the Year	1865	The Crag Foraminifera, Part 1, by Messrs. T. Rupert Jones, W. K. Parker, and H. B. Brady, 4 plates. Supplement to the Fossil Corals, Part I, Tertiary, by Dr. Duncan, 10 plates. The Fossil Merostomata, Part I, Pterygotus, by Mr. H. Woodward, 9 plates. The Fossil Brachiopoda, Vol. III, Part VII, No. 1, Silurian, by Mr. Davidson, 12 plates.
„ XX.*	„	1866	Supplement to the Fossil Corals, Part IV, No. 1, Liassic, by Dr. Duncan, 11 plates. The Trilobites of the Silurian, Devonian, &c., Formations, Part IV (Silurian), by Mr. J. W. Salter, 6 plates. The Fossil Brachiopoda, Vol. III, Part VII, No. 2, Silurian, by Mr. Davidson, 10 plates. The Belemnitidæ, Part III, Liassic Belemnites, by Prof. Phillips, 13 plates.
„ XXI.*	„	1867	Flora of the Carboniferous Strata, Part I, by Mr. E. W. Binney, 6 plates. Supplement to the Fossil Corals, Part IV, No. 2, Liassic, by Dr. Duncan, 6 plates. The Fossil Echinodermata, Cretaceous, Vol. I, Part II, by Dr. Wright, 14 plates. The Fishes of the Old Red Sandstone, Part I, by Messrs. J. Powrie and E. Ray Lankester, 5 plates. The Pleistocene Mammalia, Part II, Felis spelæa, continued, by Messrs. W. Boyd Dawkins and W. A. Sanford, 14 plates.
„ XXII.*	„	1868	Supplement to the Fossil Corals, Part II, No. 1, Cretaceous, by Dr. Duncan, 9 plates. The Fossil Merostomata, Part II, Pterygotus, by Mr. H. Woodward, 6 plates. The Fossil Brachiopoda, Vol. III, Part VII, No. 3, Silurian, by Mr. Davidson, 15 plates. The Belemnitidæ, Part IV, Liassic and Oolitic Belemnites, by Prof. Phillips, 7 plates. The Reptilia of the Kimmeridge Clay, No. 3, by Prof. Owen, 4 plates. The Pleistocene Mammalia, Part III, Felis spelæa, concluded, with F. lynx, by Messrs. W. Boyd Dawkins and W. A. Sanford, 6 plates.
„ XXIII.*	„	1869	Supplement to the Fossil Corals, Part II, No. 2, Cretaceous, by Dr. Duncan, 6 plates. The Fossil Echinodermata, Cretaceous, Vol. I, Part III, by Dr. Wright, 10 plates. The Belemnitidæ, Part V, Oxford Clay, &c., Belemnites, by Prof. Phillips, 9 plates. The Fishes of the Old Red Sandstone, Part I (concluded), by Messrs. J. Powrie and E. Ray Lankester, 9 plates. The Reptilia of the Liassic Formations, Part II, by Prof. Owen, 4 plates. The Crag Cetacea, No. 1, by Prof. Owen, 5 plates.
„ XXIV.*	„	1870	The Flora of the Carboniferous Strata, Part II, by Mr. E. W. Binney, 6 plates. The Fossil Echinodermata, Cretaceous, Vol. I, Part IV, by Dr. Wright, 10 plates. The Fossil Brachiopoda, Vol. III, Part VII, No. 4, Silurian, by Mr. Davidson, 13 plates. The Eocene Mollusca, Part IV, No. 3, Bivalves, by Mr. S. V. Wood, 5 plates. The Fossil Mammalia of the Mesozoic Formations, by Prof. Owen, 4 plates.
„ XXV.*	„	1871	The Flora of the Carboniferous Strata, Part III, by Mr. E. W. Binney, 6 plates. The Fossil Merostomata, Part III, Pterygotus and Slimonia, by Mr. H. Woodward, 5 plates. Supplement to the Crag Mollusca, Part I (Univalves), by Mr. S. V. Wood, with an Introduction on the Crag District, by Messrs. S. V. Wood, jun., and F. W. Harmer, 7 plates and map. Supplement to the Reptilia of the Wealden (Iguanodon), No. IV, by Prof. Owen, 3 plates The Pleistocene Mammalia, Part IV, Felis pardus, &c., by Messrs W. Boyd Dawkins and W. A. Sanford, 2 plates. The Pleistocene Mammalia, Part V, Ovibos moschatus, by Mr. W. Boyd Dawkins, 5 plates.
„ XXVI*	„	1872	Supplement to the Fossil Corals, Part III (Oolitic), by Prof. Duncan, with an Index to the Tertiary and Secondary Species, 7 plates. The Fossil Echinodermata, Cretaceous, Vol. I, Part V, by Dr. Wright, 5 plates. The Fossil Merostomata, Part IV (Stylonurus, Eurypterus, Hemiaspis), by Mr. H. Woodward, 10 plates. The Fossil Trigoniæ, No. I, by Dr. Lycett, 9 plates.
„ XXVII.*	„	1873	The Fossil Echinodermata, Cretaceous, Vol I, Part VI, by Dr. Wright, 8 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part I (Tertiary and Cretaceous), by Mr. Davidson, 8 plates. Supplement to the Crag Mollusca, Part II (Bivalves), by Mr. S. V. Wood, 5 plates. Supplement to the Reptilia of the Wealden (Iguanodon), No. V, by Prof. Owen, 2 plates. Supplement to the Reptilia of the Wealden (Hylæochampsa) No. VI, by Prof. Owen. The Fossil Reptilia of the Mesozoic Formations, Part I, by Prof. Owen, 2 plates.

* These Volumes are issued in two forms of binding; first, with all the Monographs stitched together and enclosed in one cover; secondly, with each of the Monographs separate, and the whole of the separate parts placed in an envelope. The previous Volumes are not in separate parts.

CATALOGUE OF WORKS—Continued.

Vol. XXVIII*	Issued for the Year 1874	The Post-Tertiary Entomostraca, by Mr. G. S. Brady, Rev. H. W. Crosskey, and Mr. D. Robertson, 16 plates. The Carboniferous Entomostraca, Part I (Cypridinadæ), by Prof. T. Rupert Jones and Messrs. J. W. Kirkby and G. S. Brady, 5 plates. The Fossil Trigoniæ, No. II, by Dr. Lycett, 10 plates.
„ XXIX*	„ 1875	The Flora of the Carboniferous Strata, Part IV, by Mr. E. W. Binney, 6 plates. The Fossil Echinodermata, Cretaceous, Vol. I, Part VII, by Dr. Wright, 10 plates. The Fossil Trigoniæ, No. III, by Dr. Lycett, 8 plates. The Fossil Reptilia of the Mesozoic Formations, Part II, by Prof. Owen, 20 plates.
„ XXX.*	„ 1876	The Carboniferous and Permian Foraminifera (the genus Fusulina excepted), by Mr. H. B. Brady, 12 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part II, No. 1 (Jurassic and Triassic), by Mr. Davidson, 8 plates. Supplement to the Reptilia of the Wealden (Poikilopleuron and Chondrosteosaurus) No. VII, by Prof. Owen, 6 plates.
„ XXXI.*	„ 1877	Supplement to the Eocene Mollusca (Bivalves), by Mr. S. V. Wood, 2 plates. The Fossil Trigoniæ, No. IV, by Dr. Lycett, 13 plates. The Eocene Mollusca (Univalves), Part IV, by Mr. S. V. Wood, 1 plate. The Carboniferous Ganoid Fishes, Part I (Palæoniscidæ), by Dr. Traquair, 7 plates. The Fossil Reptilia of the Mesozoic Formations, Part III, by Prof. Owen, 2 plates. The Fossil Elephants (E. antiquus), Part I, by Prof. Leith Adams, 5 plates.
„ XXXII.*	„ 1878	The Fossil Echinodermata, Cretaceous, Vol. I, Part VIII, by Dr. Wright, 8 plates. Index and Title Page to the Fossil Echinodermata, Oolitic, Vol. I (Echinoidea), by Dr. Wright. The Fossil Merostomata, Part V (Neolimulus, &c.), by Dr. H. Woodward, 6 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part II, No. 2 (Jurassic and Triassic), by Mr. Davidson, 13 plates. The Lias Ammonites, Part I, by Dr. Wright, 8 plates. The Sirenoid and Crossopterygian Ganoids, Part I, by Prof. Miall, 6 plates. Supplement to the Reptilia of the Wealden (Goniopholis, Petrosuchus, and Suchosaurus), No. VIII, by Prof. Owen, 6 plates. The Pleistocene Mammalia, Part A (Preliminary Treatise), by Prof. Boyd Dawkins.
„ XXXIII*	„ 1879	The Eocene Flora, Vol. I, Part I, by Mr. J. S. Gardner and Baron Ettingshausen, 5 plates. Second Supplement to the Crag Mollusca (Univalves and Bivalves), by Mr. S. V. Wood, 6 plates. The Fossil Trigoniæ, No. V (*Conclusion*), by Dr. Lycett, 1 plate. The Lias Ammonites, Part II, by Dr. Wright, 10 plates. Supplement to the Reptilia of the Wealden (Goniopholis, Brachydectes, Nannosuchus, Theriosuchus, and Nuthetes), No. IX, by Prof. Owen, 4 plates. The Fossil Elephants (E. primigenius), Part II, by Prof. Leith Adams, 10 plates.
„ XXXIV*	„ 1880	The Eocene Flora, Vol. I, Part II, by Mr. J. S. Gardner and Baron Ettingshausen, 6 plates. The Fossil Echinodermata, Oolitic, Vol. II, Part III (Asteroidea and Ophiuroidea), by Dr. Wright, 3 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part III (Permian and Carboniferous), by Mr. Davidson, 8 plates. The Lias Ammonites, Part III, by Dr. Wright, 22 plates. The Reptilia of the London Clay, Vol. II, Part I (Chelone) by Prof. Owen, 2 plates.
„ XXXV*	„ 1881	The Fossil Echinodermata, Cretaceous, Vol. I, Part IX, by Dr. Wright, 6 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part IV (Devonian and Silurian, from Budleigh-Salterton Pebble Bed), by Mr. Davidson, 5 plates. The Fossil Trigoniæ (Supplement No. 1), by Dr. Lycett. The Lias Ammonites, Part IV, by Dr. Wright, 10 plates. The Reptilia of the Liassic Formations, Part III (*Conclusion*), by Prof. Owen, 13 plates. The Fossil Elephants (E. primigenius and E. meridionalis), Part III (*Conclusion*), by Prof. Leith Adams, 13 plates.

* These Volumes are issued in two forms of binding; first, with all the Monographs stitched together and enclosed in one cover; secondly, with each of the Monographs separate, and the whole of the separate parts placed in an envelope.

CATALOGUE OF WORKS—Continued.

Vol. XXXVI*	Issued for the Year 1882	The Eocene Flora, Vol. I, Part III (*Conclusion*), by Mr. J. S. Gardner and Baron Ettingshausen, 2 plates. Third Supplement to the Crag Mollusca, by the late Mr. S. V. Wood, 1 plate. The Fossil Echinodermata, Cretaceous, Vol. I, Part X (*Conclusion*), by Dr. Wright, 5 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part V (*Conclusion*), by Dr. Davidson. Supplement to the Fossil Brachiopoda, Vol. V, Part I (Devonian and Silurian), by Dr. Davidson, 7 plates. The Lias Ammonites, Part V, by Dr. Wright, 22 plates.
„ XXXVII*	„ 1883	The Eocene Flora, Vol. II, Part I, by Mr. J. S. Gardner, 9 plates. The Trilobites of the Silurian, Devonian, &c., Formations, Part V (*Conclusion*), by the late Mr. J. W. Salter. The Carboniferous Trilobites, Part I, by Dr. H. Woodward, 6 plates. Supplement to the Fossil Brachiopoda, Vol. V, Part II (Silurian), by Dr. Davidson, 10 plates. The Fossil Trigoniæ (Supplement No. 2), by the late Dr. Lycett, 4 plates. The Lias Ammonites, Part VI, by Dr. Wright, 8 plates.
„ XXXVIII*	„ 1884	The Eocene Flora, Vol. II, Part II, by Mr. J. S. Gardner, 11 plates. The Carboniferous Entomostraca, Part I, No. 2 (*Conclusion*), by Prof. T. Rupert Jones, Mr. J. W. Kirkby, and Prof. G. S. Brady, 2 plates. The Carboniferous Trilobites, Part II, by Dr. H. Woodward, 4 plates. Supplement to the Fossil Brachiopoda, Vol. V, Part III (*Conclusion*), by Dr. Davidson, 4 plates. The Lias Ammonites, Part VII, by Dr. Wright, 10 plates.
„ XXXIX*	„ 1885	The Eocene Flora, Vol. II, Part III (*Conclusion*), by Mr. J. S. Gardner, 7 plates. The Stromatoporoids, Part I, by Prof. Alleyne Nicholson, 11 plates. The Fossil Brachiopoda (Bibliography), Vol. VI (*Conclusion*), by the late Dr. Davidson and Mr. W. H. Dalton. The Lias Ammonites, Part VIII (*Conclusion*), by the late Dr. Wright, 1 plate.
„ XL*	„ 1886	The Morphology and Histology of Stigmaria Ficoides, by Prof. W. C. Williamson, 15 plates. The Fossil Sponges, Part I, by Dr. G. J. Hinde, 8 plates. The Jurassic Gasteropoda, Part I, No. 1, by Mr. W. H. Hudleston. The Inferior Oolite Ammonites, Part I, by Mr. S. S. Buckman, 6 plates. The Pleistocene Mammalia, Part VI, by Prof. Boyd Dawkins, 7 plates.
„ XLI*	„ 1887	The Fossil Sponges, Part II, by Dr. G. J. Hinde, 1 plate. The Palæozoic Phyllopoda, Part I, by Prof. T. R. Jones and Dr. Woodward, 12 plates. The Jurassic Gasteropoda, Part I, No. 2, by Mr. W. H. Hudleston, 6 plates. The Inferior Oolite Ammonites, Part II, by Mr. S. S. Buckman, 8 plates.
„ XLII*	„ 1888	The Stromatoporoids, Part II, by Prof. Alleyne Nicholson, 8 plates. The Tertiary Entomostraca (Supplement), by Prof. T. Rupert Jones and Mr. C. D. Sherborn, 3 plates. The Jurassic Gasteropoda, Part I, No. 3, by Mr. W. H. Hudleston, 5 plates. The Inferior Oolite Ammonites, Part III, by Mr. S. S. Buckman, 10 plates. The Devonian Fauna of the South of England, Part I, by the Rev. G. F. Whidborne, 4 plates. Title-pages to the Monographs on the Reptilia of the Wealden and Purbeck (Supplements), Kimmeridge Clay, and Mesozoic Formations, and on the Cetacea of the Red Crag.
„ XLIII*	„ 1889	The Cretaceous Entomostraca (Supplement), by Prof. T. Rupert Jones and Dr. G. J. Hinde, 4 plates. The Jurassic Gasteropoda, Part I, No. 4, by Mr. W. H. Hudleston, 5 plates. The Inferior Oolite Ammonites, Part IV, by Mr. S. S. Buckman, 13 plates. The Devonian Fauna of the South of England, Part II, by the Rev. G. F. Whidborne, 12 plates.
„ XLIV	„ 1890	The Stromatoporoids, Part III, by Prof. Alleyne Nicholson, 6 plates. The Fossil Echinodermata, Cretaceous, Vol. II, Part I (Asteroidea), by Mr. W. Percy Sladen, 8 plates. The Inferior Oolite Ammonites, Part V, by Mr. S. S. Buckman, 8 plates. The Devonian Fauna of the South of England, Part III, by the Rev. G. F. Whidborne, 9 plates. Title-pages to the Supplement to the Fossil Corals, by Prof. Duncan.

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§ II. LIST OF MONOGRAPHS

Completed, in course of Publication, and in Preparation.

1. MONOGRAPHS which have been COMPLETED, and which may be bound as separate Volumes, with directions for the BINDING :—

The Morphology and Histology of Stigmaria ficoides by Prof. W. C. Williamson. (*Complete with Title-page and Index in the Volume for the year* 1886.)

The Eocene Flora, Vol. I (Filices), by Mr. J. S. Gardner and Baron Ettingshausen. (*Complete in the Volumes for the years* 1879, 1880, *and* 1882. *Title-page, Index, and directions for the binding, will be found in the Volume for* 1882.)

The Eocene Flora, Vol. II (Gymnospermæ), by Mr. J. S. Gardner. (*Complete in the Volumes for the years* 1883, 1884, *and* 1885. *Title-page, Index, and directions for the binding, will be found in the Volume for* 1885.)

The Carboniferous and Permian Foraminifera (the genus Fusulina excepted), by Mr. H. B. Brady. (*Complete in the Volume for the year* 1876.)

The Tertiary, Cretaceous, Oolitic, Devonian, and Silurian Corals, by MM. Milne-Edwards and J. Haime. (*Complete in the Volumes for the years* 1849, 1851, 1852, 1853, *and* 1854. *The Title-page and Index, with corrected explanations of Plates XVII and XVIII, will be found in the Volume for the year* 1854.)

Supplement to the Tertiary, Cretaceous, Liassic, and Oolitic Corals, by Prof. Martin Duncan. (*Complete in the Volumes for the years* 1865, 1866, 1867, 1868, 1869, 1872, *and* 1890. *The Title-page, with directions for binding, will be found in the Volume for the year* 1890.)

The Polyzoa of the Crag, by Mr. G. Busk. (*Complete with Title-page and Index in the Volume for the year* 1857.)

The Tertiary Echinodermata, by Professor Forbes. (*Complete with Title-page in the Volume for the year* 1852.)

The Fossil Cirripedes, by Mr. C. Darwin. (*Complete in the Volumes for the years* 1851, 1854, *and* 1858. *The Title-page will be found in the Volume for the year* 1854, *and the Index in the Volume for the year* 1858.

The Post-Tertiary Entomostraca, by Mr. G. S. Brady, the Rev. H. W. Crosskey, and Mr. D. Robertson. (*Complete, with Title-page and Index, in the Volume for the year* 1874.)

The Tertiary Entomostraca, by Prof. T. Rupert Jones. (*Complete, with Title-page and Index, in the Volume for the year* 1855.)

The Cretaceous Entomostraca, by Prof. T. Rupert Jones. (*Complete, with Title-page and Index, in the Volume for the year* 1849.)

Supplement to the Cretaceous Entomostraca, by Prof. T. Rupert Jones and Dr. G. J. Hinde. (*Complete, with Title-page and Index, in the Volume for the year* 1889.)

The Carboniferous Entomostraca, Part I (Cypridinadæ and their allies), by Prof. T. Rupert Jones, Mr. J. W. Kirkby, and Prof. G. S. Brady. (*Complete in the volumes for the years* 1874 *and* 1884. *The Title-page and Index will be found in the Volume for the year* 1884.)

The Fossil Estheriæ, by Prof. T. Rupert Jones. (*Complete, with Title-page and Index, in the Volume for the year* 1860.)

The Trilobites of the Cambrian, Silurian, and Devonian Formations, by Mr. J. W. Salter. (*Complete in the Volumes for the years* 1862, 1863, 1864, 1866, *and* 1883. *The Title-page and Index, with directions for the binding, will be found in the Volume for the year* 1883.)

The Fossil Merostomata, by Dr. H. Woodward. (*Complete in the Volumes for the years* 1865, 1868, 1871, 1872, *and* 1878. *The Title-page and Index, with directions for the binding, will be found in the Volume for the year* 1878.)

The Fossil Brachiopoda (Tertiary, Cretaceous, Oolitic, and Liassic), Vol. I, by Mr. T. Davidson. (*Complete in the Volumes for the years* 1850, 1852, 1853, *and* 1854. *The Index will be found in the Volume for the year* 1854, *and corrected Title-page in that for* 1870.)

The Fossil Brachiopoda (Permian and Carboniferous), Vol. II, by Mr. T. Davidson. (*Complete in the Volumes for the years* 1856, 1857, 1858, 1859, *and* 1860. *The Index will be found in the Volume for the year* 1860, *and corrected Title-page in that for* 1870.)

The Fossil Brachiopoda (Devonian and Silurian), Vol. III, by Mr. T. Davidson. (*Complete in the Volumes for the years* 1862, 1863, 1865, 1866, 1868, *and* 1870. *The Title-page and Index will be found in the Volume for the year* 1870.)

The Fossil Brachiopoda, Vol. IV, by Dr. T. Davidson. Supplements: Tertiary, Cretaceous, Jurassic, Triassic, Permian, and Carboniferous. (*Complete in the Volumes for the years* 1873, 1876, 1878, 1880, 1881, *and* 1882. *The Title-page and Index, with directions for the binding will be found in the Volume for the year* 1882.)

The Fossil Brachiopoda, Vol. V, by Dr. T. Davidson. Supplements: Devonian and Silurian. Appendix to Supplements, General Summary, Catalogue and Index of the British Species. (*Complete in the Volumes for the years* 1882, 1883, *and* 1884. *The Title-page, with directions for the binding will be found in the Volume for* 1884.)

The Fossil Brachiopoda, Vol. VI, by Dr. T. Davidson and Mr. W. H. Dalton. Bibliography. (*Complete in the Volume for the year* 1885.)

The Eocene Bivalves, Vol. I, by Mr. S. V. Wood. (*Complete, with Title-page and Index, in the Volumes for the years* 1859, 1862, *and* 1870. *The directions for the binding will be found in the Volume for the year* 1870.)

Supplement to the Eocene Bivalves, by Mr. S. V. Wood. (*Complete, with Title-page and Index, in the Volume for the year* 1877.)

The Eocene Cephalopoda and Univalves, Vol. I, by Mr. F. E. Edwards and Mr. S. V. Wood. (*Complete in the Volumes for the years* 1848, 1852, 1854, 1855, 1858, *and* 1877. *The Title-page, Index, and directions for the binding, will be found in the Volume for the year* 1877.)

The Mollusca of the Crag, Vol. I, Univalves, by Mr. S. V. Wood. (*The Text, Plates, and Index, will be found in the Volume for the year* 1847, *and the Title-page will be found in the Volume for the year* 1855.)

The Mollusca of the Crag, Vol. II, Bivalves, by Mr. S. V. Wood. (*Complete in the Volumes for the years* 1850, 1853, 1855, 1858, *and* 1873. *The Title-page will be found in the Volume for the year* 1873, *and the Index will be found in the Volume for the year* 1855, *and a Note in the Volume for the year* 1858).

The Mollusca of the Crag, Vol. III, Supplement, by Mr. S. V. Wood. (*Complete in the Volumes for the years* 1871 *and* 1873. *The Title-page and Index will be found in the Volume for the year* 1873.)

Second Supplement to the Crag Mollusca, by Mr. S. V. Wood. (*Complete, with Title-page and Index, in the Volume for the year* 1879.)

Third Supplement to the Crag Mollusca, by Mr. S. V. Wood. (*Complete, with Title-page and Index, in the Volume for the year* 1882.)

The Great Oolite Mollusca, by Professor Morris and Dr. Lycett. (*Complete in the Volumes for the years* 1850, 1853, *and* 1854. *The Title-page and Index will be found in the Volume for the year* 1854.)

The Fossil Trigoniæ, by Dr. Lycett. (*Complete in the Volumes for the years* 1872, 1874, 1875, 1877, *and* 1879. *The directions for the binding will be found in the Volume for the year* 1879.)

Supplement to the Fossil Trigoniæ, by Dr. Lycett. (*Complete in the Volumes for the years* 1881 *and* 1883. *The Title-page, Index, with directions for the binding, will be found in the Volume for the year* 1883.)

The Oolitic Echinodermata, Vol. I, Echinoidea, by Dr. Wright. (*Complete in the Volumes for the years* 1855, 1856, 1857, 1858, *and* 1878. *Title-page, Index, and directions for the binding, will be found in the Volume for the year* 1878.)

The Oolitic Echinodermata, Vol. II, Asteroidea, by Dr. Wright. (*Complete in the Volumes for the years* 1861, 1864, *and* 1880. *Title-page, Index, and directions for the binding, will be found in the Volume for the year* 1880).

The Cretaceous Echinodermata, Vol. I, Echinoidea, by Dr. Wright. (*Complete in the Volumes for the years* 1862, 1867, 1869, 1870, 1872, 1873, 1875, 1878, 1881, *and* 1882. *The Title-page and Index, with directions for the binding, will be found in the Volume for the year* 1882.)

The Cretaceous (Upper) Cephalopoda, by Mr. D. Sharpe. (*Complete in the Volumes for the years* 1853, 1854, *and* 1855, *but wants Title-page and Index.*)

The Lias Ammonites, by Dr. Wright. (*Complete in the Volumes for the years* 1878, 1879, 1880, 1881, 1882, 1883, 1884, *and* 1885. *The Title-page and Index, with directions for the binding, will be found in the Volume for the year* 1885.)

The Fossils of the Permian Formation, by Professor King. *Complete, with Title-page and Index, in the Volume for the year* 1849. *Corrected explanations of Plates XXVIII and XXVIII* will be found in the Volume for the year* 1854.)

The Reptilia of the London Clay (and of the Bracklesham and other Tertiary Beds), Vol. I, by Professors Owen and Bell. (*Complete in the Volumes for the years* 1848, 1849, 1856, *and* 1864. *Directions for the binding, Title-page, and Index, will be found in the Volume for the year* 1864.) Part I of Vol. II, containing Chelone gigas (*to be found in the Volume for the year* 1880), can be added.

The Reptilia of the Cretaceous Formations, by Prof. Owen. (*Complete in the Volumes for the years* 1851, 1857, 1858, 1862, *and* 1864. *Directions for the binding, Title-page, and Index, will be found in the Volume for the year* 1864.)

The Reptilia of the Wealden and Purbeck Formations, by Professor Owen. (*Complete in the Volumes for the years* 1853, 1854, 1855, 1856, 1857, 1858, 1862, *and* 1864. *Directions for the binding, Title-pages, and Index, will be found in the Volume for the year* 1864.)

The Reptilia of the Wealden and Purbeck Formations (Supplements 4—9), by Professor Owen. (*Complete in the Volumes for the years* 1871, 1873, 1876, 1878, 1879, *and* 1888. *Directions for the binding, Title-page, Preface, and Table of Contents, will be found in the Volume for the year* 1888.)

The Reptilia of the Kimmeridge Clay Formation, by Professor Owen. (*Complete in the Volumes for the years* 1859, 1860, 1868, and 1888. *Directions for the binding, Title-page, Preface, and Table of Contents, will be found in the Volume for the year* 1888.)

The Reptilia of the Liassic Formations, by Professor Owen. (*Complete in the Volumes for the years* 1859, 1860, 1863, 1869, *and* 1881. *Directions for the binding, Title-pages, and Index, will be found in the Volume for the year* 1881.)

The Reptilia of the Mesozoic Formations, by Professor Owen. (*Complete in the Volume for the years* 1873, 1875, 1877, *and* 1888. *Directions for the binding, Title-page, Preface, and Table of Contents, will be found in the Volume for the year* 1888.)

The Red Crag Cetacea, by Professor Owen. (*Complete in the Volume for the years* 1869 *and* 1888. *Directions for the binding, Title-page, Preface, and Table of Contents, will be found in the Volume for the year* 1888.)

The Fossil Mammalia of the Mesozoic Formations, by Professor Owen. (*Complete, with Title-page and Table of Contents, in the Volume for the year* 1870.)

The Fossil Elephants, by Professor Leith Adams. (*Complete in the Volumes for the years* 1877, 1879, *and* 1881. *Directions for the binding, Title-page, and Index will be found in the Volume for the year* 1881.

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2. MONOGRAPHS in course of PUBLICATION :—*

The Eocene Flora, by Mr. J. S. Gardner.
The Fossil Sponges, by Dr. G. J. Hinde.
The Crag Foraminifera, by Messrs. T. Rupert Jones, W. K. Parker, and H. B. Brady.†
The Stromatoporoids, by Prof. H. Alleyne Nicholson.
The Jurassic Gasteropoda, by Mr. W. H. Hudleston.
The Palæozoic Phyllopoda, by Prof. T. Rupert Jones and Dr. H. Woodward.
The Trilobites, by Dr. H. Woodward.
The Inferior Oolite Ammonites, by Mr. S. S. Buckman.
The Belemnites, by Professor Phillips.‡
The Sirenoid and Crossopterygian Ganoids, by Professor Miall.
The Fishes of the Carboniferous Formation, by Prof. Traquair.
The Fishes of the Old Red Sandstone, by Messrs. J. Powrie and E. Ray Lankester, and Professor Traquair.
The Pleistocene Mammalia, by Messrs. Boyd Dawkins and W. A. Sanford.
The Fauna of the Devonian Formation of the South of England, by the Rev. G. F. Whidborne.

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3. MONOGRAPHS which are in course of PREPARATION :—*

The Fossil Cycadeæ, by Mr. W. Carruthers.
The Graptolites, by Prof. Lapworth.
The Carboniferous Entomostraca, Part II (Leperditiadæ), by Prof. T. Rupert Jones.
The Wealden, Purbeck, and Jurassic Entomostraca, by Prof. T. R. Jones.
The Purbeck Mollusca, by Mr. R. Etheridge.
The Rhætic Mollusca, by Mr. R. Etheridge.
The Cambrian Fossils, by Dr. H. Hicks.
The Silurian Fish Bed, by Dr. Harley.
The Fossils of the Budleigh Salterton Pebble Bed, by the Rev. G. F. Whidborne.

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* Members having specimens which might assist the authors in preparing their respective Monographs are requested to communicate in the first instance with the Honorary Secretary.

† Will be finished by Prof. T. Rupert Jones.

‡ Unfinished through the death of the Author, but will be continued by Mr. G. C. Crick.

§ III. Dates of the Issue of the Yearly Volumes of the Palæontographical Society.

Volume	I	for	1847	was	issued	to	the Members,	March, 1848.
,,	II	,,	1848	,,		,,	,,	July, 1849.
,,	III	,,	1849	,,		,,	,,	August, 1850.
,,	IV	,,	1850	,,		,,	,,	June, 1851.
,,	V	,,	1851	,,		,,.	,,	June, 1851.
,,	VI	,,	1852	,,		,,	,,	August, 1852.
,,	VII	,,	1853	,,		,,	,,	December, 1853.
,,	VIII	,,	1854	,,		,,	,,	May, 1855.
,,	IX	,,	1855	,,		,,	,,	February, 1857.
,,	X	,,	1856	,,		,,	,,	April, 1858.
,,	XI	,,	1857	,,		,,	,,	November, 1859
,,	XII	,,	1858	,,		,,	,,	March, 1861.
,,	XIII	,,	1859	,,		,,	,,	December, 1861.
,,	XIV	,,	1860	,,		,,	,,	May, 1863.
,,	XV	,,	1861	,,		,,	,,	May, 1863.
,,	XVI	,,	1862	,,		,,	,,	August, 1864.
,,	XVII	,,	1863	,,		,,	,,	June, 1865.
,,	XVIII	,,	1864	,,		,,	,,	April, 1866.
,,	XIX	,,	1865	,,		,,	,,	December, 1866.
,,	XX	,,	1866	,,		,,	,,	June, 1867.
,,	XXI	,,	1867	,,		,,	,,	June, 1868.
,,	XXII	,,	1868	,,		,,	,,	February, 1869.
,,	XXIII	,,	1869	,,		,,	,,	January, 1870.
,,	XXIV	,,	1870	,,		,,	,,	January, 1871.
,,	XXV	,,	1871	,,		,,	,,	June, 1872.
,,	XXVI	,,	1872	,,		,,	,,	October, 1872.
,,	XXVII	,,	1873	,,		,,	,,	February, 1874.
,,	XXVIII	,,	1874	,,		,,	,,	July, 1874.
,,	XXIX	,,	1875	,,		,,	,,	December, 1875.
,,	XXX	,,	1876	,,		,,	,,	December, 1876.
,,	XXXI	,,	1877	,,		,,	,,	February, 1877.
,,	XXXII	,,	1878	,,		,,	,,	March, 1878.
,,	XXXIII	,,	1879	,,		,,	,,	May, 1879.
,,	XXXIV	,,	1880	,,		,,	,,	May, 1880.
,,	XXXV	,,	1881	,,		,,	,,	May, 1881.
,,	XXXVI	,,	1882	,,		,,	,,	June, 1882.
,,	XXXVII	,,	1883	,,		,,	,,	October, 1883.
,,	XXXVIII	,,	1884	,,		,,	,,	December, 1884.
,,	XXXIX	,,	1885	,,		,,	,,	January, 1886.
,,	XL	,,	1886	,,		,,	,,	March, 1887.
,,	XLI	,,	1887	,,		,,	,,	January, 1888.
,,	XLII	,,	1888	,,		,,	,,	March, 1889.
,,	XLIII	,,	1889	,,		,,	,,	March, 1890.
,,	XLIV	,,	1890	,,		,,	,,	April, 1891.

the same); and in the FOURTH *and following columns, the number of pages, plates, figures, and species described in the different Monographs.*

I. SUBJECT OF MONOGRAPH.	II. Dates of the Years *for which* the volume containing the Monograph was issued.	III *m*. Dates of the Years *in which* the Monograph was published.	IV. No. of Pages of Letterpress in each Monograph.	V. No. of Plates in each Monograph.	VI. No. of Lithographed Figures and of Woodcuts.	VII. No. of Species described in the Text.
The Morphology and Histology of Stigmaria ficoides, by Prof. W. C. Williamson, COMPLETE	1886	1887	66	15	91	1
The Eocene Flora, by Mr. J. S. Gardner and Baron Ettingshausen. Vol. I, COMPLETE.....	1879, 1880, 1882	1879, 1880, 1882	87	13	151	23
„ „ by Mr. J. S. Gardner. Vol. II, COMPLETE	1883, 1884, 1885	1883, 1884, 1886	159	27	400	31
The Flora of the Carboniferous Strata, by Mr. E. W. Binney, *in course of completion*	1867, 1870, 1871, 1875	1868, 1871, 1872, 1875	147	24	141	16
The Fossil Sponges, by Dr. G. J. Hinde, *in course of completion*.....	1886, 1887	1887, 1888	188	9	337	50
The Crag Foraminifera, by Messrs. T. Rupert Jones, W. K. Parker, and H. B. Brady, *in course of completion*	1865	1866	78	4	211	43
The Carboniferous and Permian Foraminifera, by Mr. H. B. Brady, COMPLETE.....	1876	1876	166	12	266	62
The Stromatoporoids, by Prof. Alleyne Nicholson, *in course of completion*	1885, 1888, 1890	1886, 1889, 1891	205	25	364	33
The Tertiary, Cretaceous, Oolitic, Devonian, and Silurian Corals, by MM. Milne-Edwards and J. Haime, COMPLETE (*k*)	1849, 1851, 1852, 1853, 1854	1850, 1851, 1852, 1853, 1855	406	72	800	319*g*
Supplement to the Tertiary, Cretaceous, Oolitic, and Liassic Corals, by Prof. Duncan, COMPLETE	1865, 1866, 1867, 1868, 1869, 1872, 1890	1866, 1867, 1868, 1869, 1870, 1872, 1891	232	49	797	149
The Polyzoa of the Crag, by Mr. G. Busk, COMPLETE	1857	1859	145	22	641	122
The Tertiary Echinodermata, by Prof. Forbes, COMPLETE	1852	1852	39	4	144	44
The Oolitic Echinodermata, by Dr. Wright. Vol. I, COMPLETE (*l*)	1855, 1856, 1857, 1858, 1878	1857, 1858, 1859, 1861, 1878	491	43	724	120*h*
„ „ Vol. II, COMPLETE	1861, 1864, 1880	1863, 1866, 1880	207	22	232	35
The Cretaceous Echinodermata, by Dr. Wright. Vol. I, COMPLETE.....	1862, 1867, 1869, 1870, 1872, 1873, 1875, 1878, 1881, 1882	1864, 1868, 1870, 1871, 1872, 1874, 1875, 1878, 1881, 1882	390	87	1119	113
„ „ by Mr. W. Percy Sladen. Vol. II, *in course of completion*	1890	1891	28	8	71	9
The Fossil Cirripedes, by Mr. C. Darwin, COMPLETE	1851, 1854, 1858*a*	1851, 1855, 1861	137	7	320	54
The Fossil Merostomata, by Dr. H. Woodward, COMPLETE	1865, 1868, 1871, 1872, 1878	1866, 1869, 1872, 1872, 1878	265	36	365	51
The Post-Tertiary Entomostraca, by Mr. G. S. Brady, Rev. H. W. Crosskey, and Mr. D. Robertson, COMPLETE	1874	1874	237	16	515	134
The Tertiary Entomostraca, by Prof. Rupert Jones, COMPLETE	1855	1857	74	6	233	56
„ „ „ and Mr. C. D. Sherborn (Supplement), COMPLETE	1888	1889	55	3	134	48
The Cretaceous Entomostraca, by Prof. Rupert Jones, COMPLETE	1849	1850	41	7	176	31
„ „ „ and Dr. G. J. Hinde (Supplement)	1889	1890	78	4	258	46
The Carboniferous Entomostraca, by Prof. Rupert Jones and Messrs. J. W. Kirkby and Prof. G. S. Brady. Part I, COMPLETE.....	1874, 1884	1874, 1884	95	7	374	81
The Fossil Estheriæ, by Prof. Rupert Jones, COMPLETE	1860	1863	139	5	158	19*i*
		CARRIED FORWARD...	4155	527	9022	1690

Summary of the Monographs issued to the Members (*up to* APRIL, 1891)—*continued.*

I. Subject of Monograph.	II. Dates of the Years *for which* the volume containing the Monograph was issued.	III m. Dates of the Years *in which* the Monograph was published.	IV. No. of Pages of Letterpress in each Monograph.	V. No. of Plates in each Monograph.	VI. No. of Lithographed Figures and of Woodcuts.	VII. No. of Species described in the Text.
		Brought forward...	4155	527	9022	1690
The Palæozoic Phyllopoda, by Prof. Rupert Jones and Dr. H. Woodward, *in course of completion*	1887	1888	72	12	121	39
The Trilobites of the Cambrian, Silurian, and Devonian Formations, by Mr. J. W. Salter, COMPLETE	1862, 1863, 1864, 1866, 1883	1864, 1865, 1866, 1867, 1883	224	31	703	114
The Carboniferous Trilobites, by Dr. H. Woodward, COMPLETE	1883, 1884	1883, 1884	86	10	148	31
The Malacostracous Crustacea (comprising those of the London Clay, Gault, and Greensands), by Prof. T. Bell, *in course of completion*	1856, 1860	1858, 1863	88	22	215	50
The Fossil Brachiopoda, Vol. I. The Tertiary, Cretaceous, Oolitic, and Liassic Brachiopoda, by Mr. T. Davidson, COMPLETE	1850, 1852, 1853, 1854	1851, 1852, 1853, 1855	409	42	1855	160
„ „ Vol. II. The Permian and Carboniferous Brachiopoda, COMPLETE	1856*d*, 1857, 1858, 1859, 1860	1858, 1859, 1861, 1861, 1863	331	59	1909	157
„ „ Vol. III. The Devonian and Silurian Brachiopoda, COMPLETE	1862, 1863, 1865, 1866, 1868, 1870	1864, 1865, 1866, 1867, 1869, 1871	528	70	2766	321
„ „ Vol. IV. Supplements, Tertiary to Carboniferous, COMPLETE	1873, 1876, 1878, 1880, 1881, 1882	1874, 1876, 1878, 1880, 1881, 1882	383	42	1664	215
„ „ Vol. V. Supplements, Devonian and Silurian, COMPLETE	1882, 1883, 1884	1882, 1883, 1884	476	21	1135	116
„ „ Vol. VI. Bibliography, COMPLETE	1885	1886	163	—	—	—
The Fossil Trigoniæ, by Dr. Lycett, COMPLETE	1872, 1874, 1875, 1877, 1879	1872, 1874, 1875, 1877, 1879	246	41	446	115
Supplement to the Fossil Trigoniæ, by Dr. Lycett, COMPLETE	1881, 1883	1881, 1883	19	4	53	9½
The Mollusca of the Crag, by Mr. S. V. Wood:—						
Vol. I. (Univalves), COMPLETE	1847, 1855*b*	1848, 1857	216	21	581	244
Vol. II. (Bivalves), COMPLETE	1850, 1853, 1855, 1858*c*	1851, 1853, 1857, 1861	344	31	691	253
Supplements to the Crag Mollusca, No. I and II, by Mr. S. V. Wood, COMPLETE	1871, 1873, 1879	1872, 1874, 1879	322	18	517	232
„ „ No. III „ COMPLETE	1882	1882	24	1	29	13
The Eocene Mollusca, Cephalopoda and Univalves, by Mr. F. E. Edwards, continued by Mr. S. V. Wood. Vol. I, COMPLETE	1848, 1852, 1854, 1855, 1858, 1877	1849, 1852, 1855, 1857, 1861, 1877	361	34	625	275
The Eocene Mollusca, Bivalves, by Mr. S. V. Wood. Vol. I, COMPLETE	1859, 1862, 1870	1861, 1864, 1871	182	25	531	194
Supplement to the Eocene Mollusca, by Mr. S. V. Wood (Bivalves). Vol. I, COMPLETE	1877	1877	24	2	66	30
The Great Oolite Mollusca, by Prof. Morris and Dr. Lycett, COMPLETE	1850, 1853, 1854	1851, 1853, 1855	282	30	846	419
„ „ „ Supplement by Dr. Lycett, COMPLETE	1861	1863	129	15	337	194
The Jurassic Gasteropoda, by Mr. W. H. Hudleston, *in course of completion*	1886, 1887, 1888, 1889	1887, 1888, 1889, 1890	224	16	558	162
The Inferior Oolite Ammonites, by Mr. S. S. Buckman, *in course of completion*	1886, 1887, 1888, 1889, 1890	1887, 1888, 1889, 1890, 1891	256	45	545	75
The Liassic Ammonites, by Dr. Wright, COMPLETE	1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885	1878, 1879, 1880, 1881, 1882, 1883, 1884, 1886	503	91	726	107
		Carried forward...	10047	1210	26089	5215

Summary of the Monographs issued to the Members (*up to* APRIL, 1891)—*continued.*

I. Subject of Monograph.	II. Dates of the Years *for which* the volume containing the Monograph was issued.	III m. Dates of the Years *in which* the Monograph was published.	IV. No. of Pages of Letterpress in each Monograph.	V. No. of Plates in each Monograph.	VI. No. of Lithographed Figures and of Woodcuts.	VII. No. of Species described in the Text.
		Brought forward...	10047	1210	26069	5215
The Belemnites, by Prof. Phillips, *in course of completion*	1863, 1864, 1866, 1868, 1869	1865, 1866, 1867, 1869, 1870	128	36	622	69
The Upper Cretaceous Cephalopoda, by Mr. D. Sharpe, COMPLETE	1853, 1854, 1855	1853, 1855, 1857	67	27	319	79
The Fossils of the Permian Formation, by Prof. King, COMPLETE	1849, 1854*e*	1850, 1855	287	29	511	138
The Fauna of the Devonian Formation of the South of England, by the Rev. G. F. Whidborne, *in course of completion*	1888, 1889, 1890	1889, 1890, 1891	252	25	606	154
The Sirenoid Ganoids, by Prof. Miall, *in course of completion*	1878	1878	32	6	61	6
The Fishes of the Carboniferous Formation, by Dr. Traquair, *in course of completion*	1877	1877	60	7	58	5
The Fishes of the Old Red Sandstone, by Messrs. J. Powrie and E. Ray Lankester, *in course of completion*	1867, 1869	1868, 1870	62	14	195	21
The Reptilia of the London Clay [and of the Bracklesham and other Tertiary Beds], by Profs. Owen and Bell, Vol. I, COMPLETE‡	1848, 1849, 1856*f*	1849, 1850, 1859	150	58	304	39
„ „ Vol. II, Part I, by Prof. Owen, COMPLETE	1880	1880	4	2	4	1
The Reptilia of the Cretaceous Formations, by Prof. Owen, COMPLETE‡	1851, 1857, 1858, 1862	1851, 1859, 1861, 1864	184	59	519	26
The Reptilia of the Wealden and Purbeck Formations (with Supplements 1, 2, 3), by Prof. Owen, COMPLETE‡	1853, 1854, 1855, 1856, 1857, 1858, 1862	1853, 1855, 1857, 1858, 1859, 1861, 1864	155	62	251	17
The Reptilia of the Wealden and Purbeck Formations (Supplements 4—9), COMPLETE	1871, 1873, 1876, 1878, 1879, 1888*n*	1872, 1874, 1876, 1878, 1879, 1889	85	21	175	15
The Reptilia of the Kimmeridge Clay Formation, by Prof. Owen, COMPLETE	1859, 1860, 1868, 1888*n*	1861, 1863, 1869, 1889	16	6	23	4
The Reptilia of the Liassic Formations, by Prof. Owen, COMPLETE	1859,‖ 1860,‖ 1863, 1869, 1881*n*	1861, 1863, 1865, 1870, 1881	174	50	276	20
The Reptilia of the Mesozoic Formations, by Prof. Owen, COMPLETE	1873, 1875, 1877, 1888*n*	1874, 1875, 1877	101	24	165	17
The Red Crag Cetacea, by Prof. Owen, COMPLETE	1869, 1888*n*	1870, 1889	42	5	43	9
The Fossil Elephants, by Prof. Leith Adams, COMPLETE	1877, 1879, 1881*n*	1877, 1879, 1881	265	28	216	3
The Pleistocene Mammalia, by Messrs. W. Boyd Dawkins and W. A. Sanford, *in course of completion*	1864, 1867, 1868, 1871, 1878, 1886	1866, 1868, 1869, 1872, 1878, 1887	333	39	340	12
The Mammalia of the Mesozoic Formations, by Prof. Owen, COMPLETE	1870	1871	115	4	247	30
		Total.....	12559	1712	31024	5880

a Index. *b* Title-page to Univalves. *c* Note to Crag Mollusca. *d* Contains the Permian. *e* Two corrections of Plates. *f* Supplement.
g Many of the species are described, but not figured. *h* British species only reckoned. *i* British species only reckoned. *k* A Supplement is now in course of publication.
l Index will be found in 1878 vol. *m* Useful for establishing the dates of new species. *n* Contains title-pages and directions for binding.
‡ Title-pages and Index will be found in the 1864 Volume. ‖ Marked on outside label 'Reptilia of Oolitic Formations.'

§ V. Stratigraphical Table *exhibiting the* British Fossils *already figured and described in the* Annual Volumes (1847—1890) *of the* Palæontographical Society.

	PLANTS.	PROTOZOA.		RADIATA.		ARTICULATA.					
		Sponges.	Foraminifera.	Stromatoporoids and Corals.	Echinodermata.	Cirripedes.	Cypridæ, Cytherinæ, &c.	Phyllopoda.	Merostomata.	Trilobites.	Malacostracous Crustacea.
Pleistocene	...	...	...	...	.....	.....	1874, 1888				
Crag	...	...	1865	1849	1852	1851, 1854	1888				
Eocene	1879, 1880, 1882, 1883, 1884, 1885	...	...	1849, 1865	1852	1851, 1854	1855, 1888	...	.....	.....	1856
Cretaceous.....	...	...	...	1849, 1868, 1869	1862, 1867, 1869, 1870, 1872, 1873, 1875, 1878, 1881, 1882, 1890	1851, 1854	1849, 1889	...	.....	.....	1860
Wealden	...	...	...	...	.....	.....	...	1860			
Oolitic	...	...	...	1851, 1872	1855, 1856, 1857, 1858, 1861, 1878, 1880	1851	...	1860			
Liassic	...	...	...	1851, 1866, 1867	1855, 1856, 1858, 1861, 1864						
Triassic	...	...	...	...	1880	.....	...	1860			
Permian	1849	1849	1849, 1876	1849, 1852	1849	.....	1849	1860			
Carboniferous...	1867, 1870, 1871, 1875, 1886	1887	1876	1852	.....	.....	1874, 1884	1860, 1887	1872, 1878	1883, 1884	
Devonian	...	1887	...	1853, 1885, 1888, 1890	.....	.....	1888	1860	1865, 1868, 1872, 1878	1862, 1888	
Silurian.	...	1886, 1887	...	1854, 1885, 1890	.....	.....	...	1887	1868, 1871, 1872, 1878	1862, 1863, 1864, 1866	
Cambrian	...	1886, 1887	...	1890	.....	.....	...	1887	.....	1864	

Note.—The numbers in the above List refer to the Volumes issued for those Dates.

STRATIGRAPHICAL TABLE *exhibiting the* BRITISH FOSSILS *already figured and described in the* ANNUAL VOLUMES (1847—1890) *of the* PALÆONTOGRAPHICAL SOCIETY (*continued*).

	MOLLUSCA.				VERTEBRATA.		
	Polyzoa.	Brachiopoda.	Monomyaria, Dimyaria, and Gasteropoda.	Cephalopoda.	Fishes.	Reptiles.	Mammalia.
Pleistocene	...	1873	.....	...	...	.....	1864, 1867, 1868, 1871, 1877, 1878, 1879, 1881, 1886
Crag	1857	1852, 1873, 1879	1847, 1850, 1853, 1855, 1871, 1873, 1879, 1882	...	...	.....	1869, 1881, 1888
Eocene	...	1852, 1873	1852, 1854, 1855, 1858, 1859, 1862, 1870, 1877	1848	...	1848, 1849, 1856, 1880	
Cretaceous.....	...	1852, 1854, 1873, 1884	1872, 1875, 1877, 1879	1853, 1854, 1855	...	1851, 1857, 1858, 1862, 1873, 1888	
Wealden	...	... ..	.....	...	...	1853, 1854, 1855, 1856, 1857, 1862, 1871, 1873, 1875, 1876, 1878, 1879	
Oolitic	...	1850, 1852, 1876, 1878, 1884	1850, 1853, 1854, 1872, 1874, 1875, 1877, 1879, 1883, 1886, 1887, 1888, 1889	1850, 1861, 1868, 1869, 1886, 1887, 1888, 1889 1890	...	(Purbeck) 1853, 1858 (Kim. Clay), 1859, 1860, 1868, 1873, 1875, 1877, 1888 (Great Oolite) 1875, 1888	1870
Liassic	...	1850, 1852, 1876, 1878, 1884	1874, 1877, 1879, 1883	1863, 1864, 1866, 1868, 1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885,	...	1859, 1860, 1863, 1869, 1873, 1881	
Triassic.....	...	1876, 1878	1879	.....	1878	.....	1870
Permian	1849	1849, 1856, 1880	1849	1849	1849	1849	
Carboniferous ...	...	1856, 1857, 1858, 1859, 1860, 1880, 1884	.....	.....	1877		
Devonian	...	1862, 1863, 1881, 1882, 1884	1890	1889	1867, 1869		
Silurian.....	...	1865, 1866, 1868, 1870, 1881, 1882, 1883					
Cambrian							

NOTE.—The numbers in the above List refer to the Volumes issued for those Dates.

THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

VOLUME FOR 1890.

LONDON:

MDCCCXCI

A MONOGRAPH

OF THE

BRITISH STROMATOPOROIDS.

BY

H. ALLEYNE NICHOLSON, M.D., D.Sc., PH.D., F.G.S.,
REGIUS PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF ABERDEEN.

PART III.—DESCRIPTION OF SPECIES.

PAGES 159—202; PLATES XX—XXV.

LONDON:
PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.
1891.

PRINTED BY
ADLARD AND SON, BARTHOLOMEW CLOSE.

In internal structure the cœnosteum consists of stout, circular or oval, radial pillars, which have a diameter of $\frac{1}{4}$ to $\frac{1}{3}$ mm., and terminate upwards in pointed extremities, each being traversed by a central canal. The pillars give rise to radiating "arms" or plates, which unite with one another in such a manner that the entire space between the pillars becomes filled with a tissue of calcareous vesicles, the convexities of which are directed upwards.

Obs.—This well-known species occurs typically in the form of laminar expansions, with an epithecate base and peduncle of attachment; but in some instances an encrusting habit of growth is observable. Young examples (Plate III, figs. 9 and 10) may be only 2 or 3 cm. in diameter and 1 mm. in thickness; but old specimens may be of greater size, perhaps a foot in diameter, and may reach a thickness of 2—3 cm. A single specimen often consists of two or more superposed colonies. The surface differs from that of many Stromatoporoids in the complete absence of "mamelons" and of any indications of an astrorhizal system, though studded throughout with prominent tubercles, which may be about $\frac{1}{3}$ mm. in height, and about the same diameter at their base. The tubercles may be placed about $\frac{1}{3}$ to $\frac{1}{4}$ mm. apart, or may be in contact, often coalescing in sinuous rows. The apices of the tubercles may be simply rounded or pointed, and may be apparently imperforate. In other cases a distinct circular aperture may be detected at the apex of a pillar, though it is not clear that this is not the result of weathering.

Vertical sections (Plate XX, fig. 1; and Fig. 18, B) show that the cœnosteum

FIG. 18.

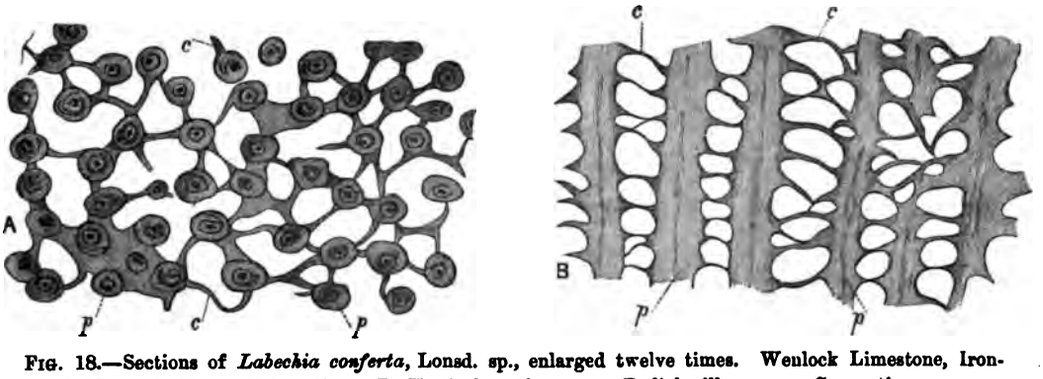


FIG. 18.—Sections of *Labechia conferta*, Lonsd. sp., enlarged twelve times. Wenlock Limestone, Ironbridge. A. Tangential section. B. Vertical section. *p p*. Radial pillars. *c c*. Connecting-processes or "arms."

is essentially composed of very stout radial pillars which spring from the basal epitheca and are continued to the upper surface, where they terminate in the prominent tubercles above spoken of. The interspaces between the pillars are occupied by a vesicular tissue formed by the coalescence of connecting-processes or "arms," given out from the pillars, the convexities of the vesicles being turned towards the upper surface.

Tangential sections (Plate XX, fig. 2; and Fig. 18, A) show that the radial pillars are hollow, each being traversed by a well-marked axial canal. The tissue forming the periphery of the pillars (Plate XX, fig. 3) is composed of very delicate laminæ, which surround the axial canal concentrically, and which often show a minute cribriform structure. The connecting-processes spring from this tissue, and can commonly be followed in vertical sections for a considerable distance into the substance of the pillars. Tangential sections further exhibit irregular dark lines connecting the transversely divided radial pillars; these lines are the cut edges of the vesicular plates or processes which fill the intervals between the pillars.

There is, apparently, a complete absence of definite zoöidal tubes or surface-apertures, and the "concentric laminæ" of the ordinary Stromatoporoids are represented solely by the vesicular tissue which unites the pillars together.

L. conferta differs from the *L. ohioensis*, Nich., of the Ordovician Rocks of North America in the fact that the radial pillars are of larger size, the surface-tubercles being correspondingly bigger, while the interstitial vesicular tissue is of a coarser type and is present in smaller amount. In its general external appearance *L. conferta* nearly resembles the *Lophiostroma* (*Labechia?*) *Schmidtii*[1] of the Silurian Rocks of the Island of Oesel; but the surface-tubercles of the latter are much larger, while the internal structure appears to be wholly different.

Distribution.—*Labechia conferta* appears to be wholly confined to the Silurian Rocks (Upper Silurian of Murchison). It is a common species in the Wenlock Limestone of Britain, occurring at Ironbridge, Dudley, Dormington, Longhope, &c. I have also specimens from the Wenlock Limestone of Gotland (collected by Prof. Lindström); but the species has not been recognised as occurring in the Silurian Rocks of Esthonia or Oesel.

2. LABECHIA SCABIOSA, n. sp. Pl. XX, figs. 4—6.

Cœnosteum forming a small discoid expansion, with a concentrically striated basal epitheca (Plate XX, fig. 5). The upper surface is flat, and is covered with irregular tubercles, which are usually multiple and are mostly placed from ½ to

[1] *Labechia? Schmidtii* was described by me at some length in the 'Annals and Magazine of Natural History,' ser. 5, vol. xviii, 1886. Judging from its apparent structure it cannot be referred to the genus *Labechia*, and I propose for it the generic name of *Lophiostroma*. The genus is characterised by the possession of a laminar cœnosteum, composed throughout of sharply undulated, closely approximated, and exceedingly thin calcareous lamellæ. The upward bendings of these lamellæ give rise to a series of spurious pillars, the superior extremities of which appear on the surface as prominent tubercles, while the downward bendings correspond with the interspaces between these. The under surface is covered with a concentrically-striated epitheca.

1 mm. apart, their size and height being variable (Plate XX, fig. 4). The only known specimen is about 2½ cm. in length by 2 cm. in width.

I have felt much hesitation in giving a name to this form, as I have only a single small specimen of it, and have therefore been unable to examine its internal structure by means of thin sections. It is clear, however, that we have to deal here with a species of *Labechia* which is distinct from *L. conferta*. The young form of the latter (Plate III, figs. 9 and 10) is an exceedingly thin, coin-shaped plate, epithecate below and tuberculate above. On the other hand, the specimen here described as *L. scabiosa* is not coin-shaped, and it is uncertain whether it is a young example or is fully grown. Moreover, the character of the tuberculation of the upper surface is very distinct from that shown in young examples of *L. conferta*, the tubercles being larger and more remote, while their distribution is irregular and does not show any radial tendency, and they are commonly multiple in structure.

Distribution.—Wenlock Limestone, Dudley.

3. LABECHIA STYLOPHORA, n. sp. Pl. XX, figs. 7 and 8.

The cœnosteum in this species is of unknown form, but is probably laminar. It consists of irregularly undulated laminæ, traversed by strong radial pillars, and so disposed as to give rise to the formation of a number of cylinders, which run at right angles to the general mass (Plate XX, fig. 7). The cylinders are about 8 or 9 mm. in diameter, and are placed about 5 mm. apart; and the radial pillars within them are so arranged as to be parallel with the axis of the cylinders in the middle line, while they are directed more or less transversely to the cylinder towards the circumference of the latter (Plate XX, fig. 8). The radial pillars are rounded or somewhat quadrangular in form, about two occupying the space of 1 mm.; and the interstitial vesicular tissue is exceedingly delicate, four or five vesicles occupying the space of a millimètre measured vertically.

Owing to the peculiar state of preservation of all the specimens of *L. stylophora* which I have seen, thin sections fail to yield any information further than that afforded by polished slabs. The species is, however, clearly distinguished from all other known forms of the genus by its unique mode of growth, its characteristic cylinders reminding one closely of the similar structures seen in the cœnosteum of *Actinostroma verrucosum*, Goldf. sp.

Distribution.—Not very uncommon in the Middle Devonian Limestones of Shaldon, South Devon.

4. LABECHIA SEROTINA, *Nich.* Fig. 19.

LABECHIA SEROTINA, *Nicholson.* Introduction, p. 45, 1885.
— — — Ann. and Mag. Nat. Hist., ser. 5, vol. xviii, p. 15, 1886.

General form and surface of the cœnosteum unknown. In internal structure the skeleton is composed of cylindrical radial pillars, which have a diameter of about $\frac{1}{8}$ mm., and which are traversed by large axial canals. The canals of the pillars are provided with curved internal partitions, which run transversely to the canal, and have their convexities turned upwards. The pillars are very rarely isolated, but are mostly in contact laterally in such a way that they give rise to sinuous rows, forming a network of much the same pattern as that produced by the corallites of *Halysites escharoides*, Lamk. sp. The interspaces between the winding rows of pillars are crossed by delicate calcareous fibres or plates, which connect the pillars together, and which are only rarely and partially vesicular. These connecting plates are usually straight, and are only occasionally curved; hence they give to vertical sections the aspect of a tabulate coral.

FIG. 19.

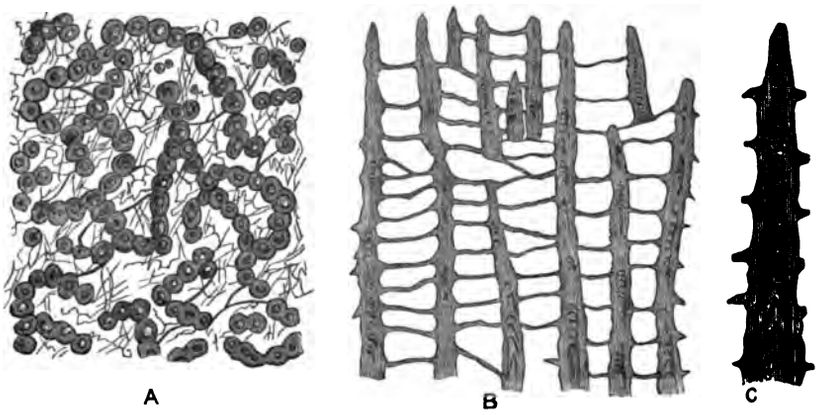


FIG. 19.—*Labechia serotina*, Nich. Devonian, Teignmouth. A. Tangential section, enlarged twelve times, showing the arrangement of the pillars in short interlacing rows, and their large axial canals. B. Vertical section, similarly enlarged, showing the partitioning of the axial canals of the pillars by transverse plates, and their connection by numerous horizontal "arms." C. A single radial pillar further enlarged, showing its pointed extremity.

The only example which I possess of this remarkable Stromatoporoid is a small polished fragment from a Devonian Limestone of Devonshire, which I purchased from Mr. Sclater, of Teignmouth. The structure of the skeleton differs so widely from that of the ordinary species of *Labechia* that it is unnecessary to compare it minutely with these. The characteristic features of *L. serotina* are

the confluence of the radial pillars into a reticulation of sinuous rows, the large size of the axial canals, the presence of curved transverse partitions in the interior of the axial canals of the pillars, and the fact that the interstitial tissue is composed of straight horizontal plates, which but rarely become vesicular, and then only to a very limited extent.

Distribution.—Middle Devonian of Devonshire. The only known specimen is in a red limestone, and is probably from the neighbourhood of Torquay.

5. LABECHIA CANADENSIS, *Nich. and Mur.* sp (?). Pl. XX, fig. 9.

STROMATOCERIUM CANADENSE, *Nicholson* and *Murie*. Journ. Linn. Soc. Zool., vol. xiv, p. 223, pl. iii, figs. 9, 10 (1878).

LABECHIA CANADENSIS. *Nicholson*. Mon. Brit. Stromatoporoids, pl. ii, figs. 3—5, 1886.

— — — Ann. and Mag. Nat. Hist., ser. 5, vol. xviii, p. 14, pl. ii, fig. 5, 1886.

Typical American examples of this species have a generally massive cœnosteum, the upper surface of which is not fully known. The skeletal tissue (Plate II, figs. 4 and 5) consists of large, comparatively remote, and irregularly developed radial pillars, which are united by a very irregularly developed vesicular interstitial tissue, the cells of which are usually of large size and irregular form, though occasionally of moderate dimensions. The vesicles have their convexities turned upwards, and the radial pillars terminate upwards in pointed extremities.

This species is distinguished from all the other forms of the genus by its irregular and often remote radial pillars, and by the large size and irregular form of the interstitial cells. The only British specimen which I should feel disposed to identify with *L. canadensis* is a massive Stromatoporoid collected by Mrs. Robert Gray in the Ordovician limestones of the neighbourhood of Girvan. Unfortunately this specimen, as, indeed, is usual in all examples of the species which I have examined, is in a highly mineralised condition, and its characters cannot therefore be determined with absolute certainty. Vertical sections (Plate XX, fig. 9) show longitudinal rows of large-sized lenticular vesicles, of very irregular dimensions, and thus closely resemble corresponding sections of typical examples of *L. canadensis*. The vesicles vary from less than a millimètre to about 3 mm. in their long diameter. On the other hand, though the vesicular tissue is sufficiently well marked, there are only obscure indications of the presence of the radial pillars, which must have existed if the species is rightly identified. Upon the whole, however, I have little doubt but that this specimen is really

referable to *L. canadensis*, since the radial pillars are commonly more or less entirely destroyed in undoubted examples of this species. If we were to suppose that radial pillars were really wanting, the specimen would have to be referred to the genus *Rosenella*, Nich.; but this reference is negatived by the fact that the upper surfaces of the vesicles, as seen in vertical sections, are quite smooth, and are completely destitute of the tubercles which are present in this situation in all species of the genus *Rosenella*.

Distribution.—A single large specimen was collected by Mrs. Robert Gray in the Aldons Limestone (Ordovician) at Aldons, near Girvan. The typical forms of the species are found in the Trenton Limestone of Peterborough and Lake Couchiching in Ontario. The species also occurs in the Ordovician Rocks ("Wassalem Beds") of Saak in Esthonia.

Family—STROMATOPORIDÆ.

Genus 1.—Stromatopora, *Goldfuss* (emend.), 1826.

(Introduction, p. 91.)

1. Stromatopora concentrica, *Goldfuss*. Pl. III, fig. 5; Pl. XI, figs. 15—18; Pl. XX, fig. 10; Pl. XXI, figs. 1—3; and Pl. XXIV, figs. 9 and 10.

	Stromatopora concentrica,		*Goldfuss*.	Petref. Germ., p. 22, pl. viii, fig. 5, 1826.
?	—	—	*Michelin*.	Iconographie Zoöphytologique, p. 190, pl. xlix, fig. 4, 1840—47.
	—	—	*Nicholson*.	Monogr. Brit. Strom., Introduction, p. 2, pl. xi, figs. 15—18, 1886.
	—	—	*Waagen* and *Wentzel*.	"Salt Range Fossils," Palæontologia Indica, No. 7, pl. cxx, figs. 4 and 5, and pl. cxxi, 1 *a*—1 *c*, 1887 (figured, from European specimens, but not described).
	—	—	*Wentzel*.	Ueber fossile Hydrocorallinen, "Lotos," Neue Folge, Bd. ix, Taf. ii, figs. 4 and 5, and Taf. iii, figs. 1 and 2 (figures only), 1889.

The cœnosteum in this species is massive, spheroidal, cylindrical or bluntly conical, or irregular in form, often attaining a very large size. The base of attachment seems to have been small, and an epithecal membrane does not appear to have been developed. The skeleton always consists of successive "latilaminæ," or concentric strata, which are generally 2 to 3 mm. in thickness, and mark periodic intermissions in the process of growth (Plate XX, fig. 10, and Plate

XXI, fig. 1). Each latilamina is made up of a number of trabecular concentric laminæ, which are simply curved or are usually but slightly undulated, the surface being, therefore, usually free from prominences. Pointed eminences or "mamelons" are, however, present in one variety of the species (*S. concentrica*, var. *colliculata*, Nich.).

Astrorhizæ are usually fairly numerous and are generally of small size (Plate XXI, fig. 3). In one form (var. *colliculata*) the astrorhizæ are disposed in vertical systems, and are often surrounded by concentrically disposed laminæ, thus giving rise to "astrorhizal cylinders;" and in another form, which may be provisionally referred here (var. *astrigera*, Nich.), the astrorhizæ are large and spreading. The surface of the cœnosteum, when well-preserved, exhibits vermiculate and inosculating ridges corresponding with the reticulated skeleton (Plate XXI, fig. 3).

As regards its internal structure, the cœnosteum is of the strictly "reticulate" type, the radial pillars and horizontal connecting-processes being fused with one another to form a continuous and complex network traversed by correspondingly complex anastomosing canals (Plate XI, figs. 16—18). Distinct zoöidal tubes, of a somewhat irregular and tortuous form, are developed, and are crossed by a moderate number of transverse partitions or "tabulæ." The skeleton-fibre itself is minutely porous in structure, and is from $\frac{1}{5}$ to $\frac{1}{6}$ mm. in diameter, the reticulated tissue which it forms being thus very dense.

Obs.—The typical examples of *Stromatopora concentrica*, Goldf., are usually spheroidal or subcylindrical in shape, and vary from about an inch up to over a foot in diameter. The latilaminæ are concentric with the general surface, and are either simply curved or are thrown into wide undulations (Plate XX, fig. 10). In the form which I have named, *S. concentrica*, var. *colliculata*, the cœnosteum is cylindrical or cylindro-conical in shape, and the latilaminæ are rolled concentrically round an imaginary central axis. Though the latilaminæ form such a conspicuous feature in this species (Plate XXI, fig. 1), it can hardly be said that this feature is developed to a greater extent in *S. concentrica*, Goldf., than it is in *S. Carteri*, Nich., or *S. typica*, Rosen, or in some other Stromatoporoids of entirely different affinities (as, for example, in certain forms of *Actinostroma stellulatum*, Nich.).

As regards its internal structure, *S. concentrica* presents the completely reticulate skeleton of all the species of *Stromatopora* proper; but the blending of the radial and horizontal elements of the cœnosteum is not so complete as to prevent the ready recognition of the radial pillars in properly prepared vertical sections. Owing to the comparative distinctness of the radial pillars (Plate XI, fig. 18) the zoöidal tubes are clearly marked out as irregular, often sinuous, vertical tubes, the internal cavities of which are crossed by remote transverse "tabulæ." Tangential sections (Plate XI, figs. 16, 17) are, in general, readily distinguished from corresponding sections of allied species of the genus by the comparative density and

closeness of the reticulation, due in part to the coarse nature of the skeleton-fibre, and in part to the proportionately small size and the irregular distribution of the canals which traverse the cœnosteum. The skeleton-fibre is minutely porous (Plate XXI, fig. 2), but in very many cases, where the skeleton has not been perfectly preserved, the pores are represented by dark or cloudy dots only.

Two principal groups of forms of *S. concentrica* may be distinguished, to which a third, of a more doubtful nature, may be provisionally added.

The first group comprises what may be considered the normal form of the species, in which the cœnosteum is spheroidal or irregular in shape, the latilaminæ are simply curved or undulated, and the surface is smooth and without "mamelons." The astrorhizæ (Plate XXI, fig. 3) are small, their centres being from 7 to 10 mm. apart, and are not surrounded by sheaths of concentrically disposed laminæ ("astrorhizal cylinders").

The forms of the second group may be included under the varietal name of *S. concentrica*, var. *colliculata*, Nich. In this variety the cœnosteum usually has the form of a thick cylinder, with a bluntly conical apex (Plate III, fig. 5), composed essentially of laminæ rolled concentrically round a vertical line. The astrorhizæ are comparatively small, but are developed in superimposed groups, and are commonly the centres of more or less definite "astrorhizal cylinders," the spaces between which are filled up by undulated and flexuous laminæ. Owing to this disposition of the astrorhizæ, the surface exhibits numerous eminences or "mamelons," which may be rounded or sometimes acuminate, or at other times more or less drawn out in the direction of the long axis of the fossil (Plate III, fig. 5). The minute structure of the skeleton in this variety does not differ in any recognisable respect from that of normal examples of the species.

To the above I may add, under the provisional name of *S. concentrica*, var. *astrigera*, Nich., a third group of forms distinguished essentially by the large size of the astrorhizæ, the centres of which may be 2 or 3 cm. apart, while their branches are comparatively few, and divide dichotomously at wide intervals (Plate XXIV, fig. 10). The only examples of this form with which I am acquainted occur in the Devonian Limestones of Devonshire, and their state of preservation is, unfortunately, such that I can say nothing as to the general form of the cœnosteum, or the condition of the surface. The best-preserved examples of this form which have come under my notice exhibit a microscopic structure of the skeleton which, except as regards the astrorhizæ, appears to agree in all essential respects with that of typical examples of *S. concentrica*. In the worse-preserved examples the skeleton has been more or less extensively replaced by calcite and its canal-system filled up with calcareous mud, thin sections thus appearing under the microscope in a "reversed" condition (Plate XXIV, fig. 9). In thin slices of such examples the astrorhizal canals often show a singular

structure, oval or circular clear spaces separated by dark intervals marking out the lines of the principal tubes (Plate XXIV, fig. 9). This curious phenomenon is easily recognised in polished sections of this form, even by the naked eye, or with a lens, but I cannot give any satisfactory explanation of it. The skeleton in this form grows in "latilaminæ," as in the ordinary examples of the present species. The large size and characteristic form of the astrorhizæ in this type might, however, perhaps justify us in considering it as a distinct *species* of *Stromatopora* rather than as a mere variety of *S. concentrica*, Goldf.

Specimens of all the three forms of *S. concentrica* above distinguished commonly occur in the "Caunopora-state." In such specimens the "Caunopora-tubes" are generally of very small size, usually about $\frac{1}{4}$ mm. in diameter, but sometimes reaching a diameter of $\frac{3}{5}$ mm. The tubes are connected with one another by horizontal stolons, as is the case with "Caunopora-tubes" generally, but I have not recognised in them any structures of the nature of "tabulæ," nor do they appear to be provided with septal spines.

S. concentrica, Goldf., is more or less nearly related to *S. Carteri*, Nich., and *S. discoidea*, Lonsd., and, in a less degree, to *S. Hüpschii*, Barg., in all of which the skeleton-fibre is thick and coarse. From *S. Hüpschii* the present species is readily distinguished by the much less open reticulation of the skeletal framework, while the radial pillars and zoöidal tubes are not so regular nor so well developed. The skeleton-fibre of *S. Hüpschii* is, moreover, even more coarse than that of *S. concentrica*, while its cœnosteum does not grow in latilaminæ. *S. discoidea*, Lond., also has a thicker skeleton-fibre than that of *S. concentrica* ($\frac{1}{4}$ to $\frac{1}{5}$ mm. in diameter as compared with $\frac{1}{5}$ to $\frac{1}{6}$ mm. in the latter); and is at once distinguished from the present species by its extraordinarily developed astrorhizal system. *S. Carteri*, Nich., again, grows in latilaminæ, but the skeleton-fibre is of a finer character than that of *S. concentrica* (about $\frac{1}{6}$ or $\frac{1}{7}$ mm. in diameter) and the general reticulation of the skeleton is much more lax and open. Moreover, the skeleton-fibre of *S. Carteri* is more coarsely porous than that of *S. concentrica*. Lastly, *S. typica*, Rosen, has a skeleton-fibre of about $\frac{1}{7}$ mm. in diameter, and the general cœnosteal tissue is much less dense than that of *S. concentrica*, while the radial pillars and tabulate zoöidal tubes are much better developed than in the latter species.

I have found it impossible to draw up a satisfactory synonymy of this species, owing to the great difficulty of determining the real nature of many of the forms described under this name by older writers. The *S. concentrica* of Michelin ('Iconographie Zoöphytologique,' p. 190, pl. xlix, fig. 4, 1840—47) is quoted from both Devonian and Silurian localities, and thus clearly cannot be relied upon; and though his figure might answer very well for that of a fragment of *S. concentrica*, Goldf., it would stand even better for one of *Actinostroma stellulatum*,

Nich. The species described by Lonsdale ('Sil. Syst.,' p. 680, pl. xv, fig. 31, 1839) as *S. concentrica* is really *Clathrodictyon striatellum*, D'Orb. sp. The form described under this name by Phillips ('Pal. Foss. of Cornwall, &c.,' p. 18, pl. x, fig. 28, 1841) appears to be an example of a hitherto undescribed Stromatoporoid which occurs commonly in the Devonian Limestones of Devonshire, and which will, I think, prove to be referable to the genus *Hermatostroma*. At any rate, the *S. concentrica* of Phillips is certainly quite distinct from the form which rightly bears this name. The fossil noted by M'Coy from the Carboniferous Limestone of Ireland ('Synopsis of the Carb. Foss. of Ireland,' p. 193, 1844), under the name of *S. concentrica*, Lonsd., is described with extreme brevity and is not figured, so that its true nature is wholly doubtful, though it may be taken for certain that it is not the present species. On the other hand, the fossil described by M'Coy from the Devonian Limestones of Devonshire as *S. concentrica*, Goldf. ('Brit. Pal. Foss,' p. 65, 1851), is clearly an *Actinostroma*, and is probably identical with *A. clathratum*, Nich. The *S. concentrica* of Bargatzky ('Die Stromatoporen des rheinischen Devons, p. 54, 1881) is unquestionably the form which I have described under the name of *Actinostroma clathratum*, and has no relationship with the *S. concentrica* of Goldfuss. Under the name of *S. concentrica*, Goldf., Prof. Ferd. Roemer ('Leth. Pal.,' p. 538, 1883) includes a number of distinct species of Stromatoporoids of Devonian age, and it is not possible to determine how far his descriptive remarks really apply to the true *S. concentrica* of Goldfuss. The figures which accompany his description (loc. cit., Atlas, Taf. xxvi, figs. 3*a*, 3*b*) would seem to be probably referable to *Actinostroma stellulatum*, Nich. The form identified as *S. concentrica*, Goldf., by Dr. Maurer ('Die Fauna der Kalke von Waldgirmes,' p. 108, Taf. ii, figs. 12, 13, 1885) is referable in reality to *Actinostroma stellulatum*, Nich., but is very badly preserved. Lastly, the form described as *S. concentrica*, Goldf., by Frech ("Die Korallenfauna des Oberdevons," 'Zeitschr. d. deutschen geol. Gesellschaft,' p. 116, Jahrg., 1885) is also an *Actinostroma*, and is apparently partly referable to *A. clathratum*, Nich., and partly based on *A. verrucosum*, Goldf. sp.

Distribution.—*Stromatopora concentrica*, Goldf., so far as at present known, is a purely European species, and is entirely confined to the Devonian Rocks. The normal form of the species occurs, not uncommonly, in the Middle Devonian Limestones in the neighbourhood of Gerolstein, and occurs also at Sötenich, but seems to be absent from the limestones of the Paffrath area. In Britain, the typical form of the species occurs in the Middle Devonian Limestones of Lummaton, in Devonshire, in strictly characteristic examples. It is also found in the Devonian pebbles of the Triassic conglomerates at Teignmouth; but it is always a rare form. The form which I have called *S. concentrica*, var. *colliculata*, is common at Gerolstein, commoner, in fact, than the normal form of

the species, and it likewise occurs at Sötenich. Examples of this variety also occur in the Devonian pebbles of Teignmouth. Lastly, the type which I have provisionally designated *S. concentrica*, var. *astrigera*, appears to be confined to the Devonian Limestones of Devonshire, occurring in the Teignmouth conglomerates, and in the limestone of Chinkenwell Quarry, near Marychurch.

2. STROMATOPORA TYPICA, *von Rosen*. Pl. I, fig. 3; Pl. V, figs. 14 and 15; Pl. XXI, figs. 4—11; and Pl. XXII, figs. 1 and 2.

STROMATOPORA TYPICA, *von Rosen*. Ueber die Natur der Stromatoporen, p. 58, Taf. i, figs. 1—3, and Taf. ii, fig. 1, 1867.
— — *Nicholson*. Monogr. Brit. Stromatoporoids, General Introduction, pl. i, fig. 3, and pl. v, figs. 14 and 15, 1886 (figured but not described).

The cœnosteum in this species is typically hemispherical or discoid, more rarely laminar, with a flattened or concave base which is covered by a concentrically wrinkled epithecal membrane (Plate XXI, figs. 4 and 5), the organism being usually attached to foreign bodies by a limited portion of its lower surface. The size of the cœnosteum varies from less than two centimètres up to a foot or more at its base.

The mode of growth is always by distinct "latilaminæ," which are not made up of recognisable finer concentric laminæ, and which are always gently curved or bent, the exterior being thus destitute of conspicuous eminences or "mamelons." The surface, in well-preserved examples, shows a minutely vermiculate network (Plate XXI, fig. 7), pierced by innumerable small and close-set circular apertures, representing the mouths of the zoöidal tubes. Astrorhizæ are always developed in great numbers, but are slightly branched, and are of small size, their centres averaging about 6 mm. apart. They may be superimposed in vertical systems, with a common axial canal to each system; but this arrangement is rarely distinct, each astrorhiza usually showing two or more small apertures at its centre where it terminates on the surface.

As regards its internal structure, the skeleton is completely "reticulate," the horizontal elements of the cœnosteum ("connecting-arms") being indistinctly developed as separate from the radial pillars. The skeleton-fibre is about $\frac{1}{7}$ mm. in diameter, and is minutely porous (Plate XXI, figs. 9 and 10), the network formed by its inosculations being of a close and fine character. Vertical sections (Plate XXII, fig. 2) show that the radial pillars are quite distinct, and are separated by well-developed, approximately vertical zoöidal tubes, the cavities of which are intersected by numerous transverse partitions or "tabulæ." From six to eight

zoöidal tubes, with their intervening radial pillars, occupy a space of 2 mm. measured at right angles to their length. Tangential sections (Plate XXII, fig. 1) show the finely reticulated skeletal network, pierced by the generally round openings of the transversely divided zoöidal tubes and traversed by the branching astrorhizal canals. The latilaminar structure of the skeleton is also well exhibited by vertical sections.

Obs.—The form of the cœnosteum in *S. typica* is essentially discoidal, with a basal epitheca, the smallest example seen being 1½ cm. in diameter. Young specimens (Plate XXI, figs. 4—6) are thin, approximately circular discs, fixed basally to foreign objects by a small peduncle of attachment, or, at other times, by a large portion of the under surface. In some cases the discoidal or laminar form is more or less completely retained throughout life, few latilaminæ being produced, and these being widely extended laterally. More usually, the successively produced latilaminæ not only extend beyond the margins of the previously formed disc, the cœnosteum thus increasing in diameter; but each stratum is thicker in the middle than at the periphery, so that the colony assumes a hemispherical shape, with a flat or concave base (Plate XXI, fig. 8). Large specimens may exceed a foot in diameter, but the hemispherical form is usually more or less closely retained.

Latilaminar growth is almost as marked a feature as in *S. concentrica*, Goldf., each latilamina consisting of a single layer of zoöidal tubes. The latilaminæ are always in gentle curves or slight undulations, conforming with the surface of the hemispherical cœnosteum. The astrorhizæ of *S. typica* are characteristic in their great numbers, small size, and few straggling branches (Plate XXI, fig. 7). Usually their centres are 5 or 6 mm. apart, but they may be more widely spaced than this. An arrangement of the astrorhizæ into vertically superimposed systems, each with a common axial canal, can often be made out; but this is not a conspicuous feature, and "astrorhizal cylinders" are never developed, the surface of each successive latilamina being thus devoid of eminences or "mamelons" corresponding with the astrorhizal centres.

The skeleton-fibre (Plate I, fig. 3, and Plate XXI, figs. 9 and 10) is minutely porous, and this structure is more or less clearly recognisable in all well-preserved examples. In some examples, however, the skeleton-fibre appears to have undergone a sort of change, in virtue of which it appears in vertical sections as if traversed by innumerable perpendicular and horizontal dark striæ. This appearance has been figured by Baron von Rosen ('Ueber die Nat. der Strom.,' Taf. i, fig. 2), and is not uncommonly seen in specimens from Gotland or Esthonia, but only in examples which can be otherwise shown to have undergone more or less alteration. As has been previously pointed out (p. 145), vertical sections of specimens in which the skeleton-fibre has been altered in the way just described

show a singular resemblance to corresponding sections of *Actinostroma astroites*, von Rosen, sp.

Owing to the imperfect development of the horizontal elements of the skeleton as distinct structures, "concentric laminæ," in the strict sense of the term, can hardly be said to exist, the skeletal tissue being thoroughly reticulate. Tangential sections (Plate XXII, fig. 1) exhibit a close calcareous network, traversed horizontally or more or less obliquely by the branching astrorhizal canals, and pierced by close-set oval or circular pores, representing transverse sections of the zoöidal tubes. On the other hand, vertical sections (Plate XXII, fig. 2) show that each latilamina consists of a series of closely arranged slightly flexuous radial pillars, which probably run from the bottom to the top of the latilamina without a break, though they are necessarily so cut in sections as to appear to be more or less discontinuous. The radial pillars are connected at intervals by irregularly developed horizontal processes, but their individuality is not thereby destroyed. Vertical sections, also, always show very distinctly developed and freely tabulate zoöidal tubes, which, like the radial pillars, are probably really continuous from the bottom to the top of each latilamina.

I have never seen a British example of *S. typica* in the "Caunopora-state." Prof. Ferdinand Roemer has, however, presented to me an example of this species from the Drift of Northern Germany, in which the skeleton is traversed by numerous minute "Caunopora-tubes." I have given a figure of a portion of the surface of this specimen (Plate XXI, fig. 11), from which it will be seen that, in this case, the "Caunopora-tubes" probably belong to a species of *Aulopora*. Professor Lindström, moreover, has recently shown ('Bihang till k. Svenska Vet. Akad. Handlingar,' Bd. xv, Afd. iv, No. 9, 1889) that the curious fossil described by Kunth under the name of *Prisciturben* is really a kind of "Caunopora," in which the imbedded tubes belong to a Cyathophylloid coral. The original specimen of *Prisciturben* was derived from the Wenlock Limestone of Sweden (apparently from Gotland), and was supposed by Kunth to be a peculiar type of Coral ("Beiträge zur Kenntniss fossiler Korallen," 'Zeitschr. d. deutsch. geol. Gesell.,' 1870, p. 82). Lindström, however, has shown that the supposed "cœnenchyma" of *Prisciturben* is really a mass of *Stromatopora typica*, v. Rosen, imbedded in which, as in a matrix, are the cylindrical tubes of a Cyathophylloid coral. I have carefully examined a specimen of *Prisciturben* which I collected in the Wenlock Limestone of Oesel, and I am able to entirely corroborate Professor Lindström's observations on this subject.

The characters of *S. typica*, throughout its entire range, remain remarkably uniform; and I am not acquainted with any definite varietal forms of the species, unless the *Caunopora Hudsonica* of Dawson—to be spoken of immediately—should be regarded as one.

From *S. concentrica*, Goldf., the present species is distinguished by its much finer skeleton-fibre and the greater delicacy of the cœnosteal tissue resulting from this. The cœnosteum is, further, distinguished by its hemispherical or discoidal form, and the presence of a basal epitheca; while the zoöidal tubes are closer, more regular, and more abundantly furnished with tabulæ than is the case with the former. From both *S. Hüpschii*, Barg., and *S. discoidea*, Lonsd., the present species is distinguished, among other characters, by the comparative fineness of the skeleton-fibre and the greater delicacy of the reticulated skeleton. In *S. discoidea*, moreover, the astrorhizal system is extraordinarily developed. From *S. Carteri*, Nich., lastly, the present species is separated by its more delicate skeleton-fibre and the much less lax and open character of the skeletal network; while the former is destitute of astrorhizæ, or has these structures developed in the feeblest manner.

Stromatopora typica, Rosen, though a very abundant and very widely distributed form, seems to have been commonly overlooked by palæontologists, and I have therefore little to say as to its synonyms. I have examined von Rosen's original specimens in Dorpat, and I have collected many similar ones in the Silurian Rocks of Esthonia; so that I have no doubt as to the precise species this observer had in view, even if his excellent figures had not placed this beyond doubt. My friend Mr. J. F. Whiteaves has been good enough to send me a fragment of the original specimen of the "*Caunopora*" *Hudsonica*, described by Sir J. W. Dawson ('Quart. Journ. Geol. Soc.,' vol. xxxv, p. 52, pl. iv, fig. 9, and pl. v, fig. 10, 1879) from the Silurian Rocks of Hudson's Bay, together with another and much better preserved fragment of the same species from the Silurian of Cape Churchill. The microscopic examination of these fragments has shown that this form is a true *Stromatopora*, with very close relationships to *S. typica*, Rosen. The general character of the skeletal network is precisely similar to that of *S. typica*, except, perhaps, that it is a shade coarser than is usual in the latter species; while the minute structure of the skeleton-fibre is identical in the two. There are, in fact, only two apparent points of distinction between *S. Hudsonica*, Daws. sp., and *S. typica*, Rosen, to which any importance could be attached. One of these is that in the former the astrorhizæ are always regularly superimposed in vertical rows, each system being connected with a wall-less axial canal of comparatively large size. Each astrorhiza, therefore, opens on the surface of the latilamina to which it belongs by a comparatively large circular aperture, corresponding with the axial canal, this aperture being placed at the summit of a minute pointed eminence. The surface thus shows numerous small, regularly placed "mamelons," corresponding each with the centre of an astrorhizal system. In this character, as pointed out by Dawson, *S. Hudsonica* resembles the form described by Hall and Whitfield ('Twenty-third Ann. Rep. on the State Cabinet,' pl. ix, fig. 3,

1873) as *Cœnostroma incrustans* (Plate III, fig. 6); but it is by no means probable that these species are identical. The other point which seems to distinguish *S. Hudsonica* from *S. typica* is that the zoöidal tubes of the former seem to be provided with very few tabulæ; but much stress cannot be laid upon this, as my specimens are in a state of poor preservation. Upon the whole, it may at present be concluded that *S. Hudsonica*, Dawson sp., is specifically distinct from *S. typica*, Rosen, though certainly nearly related to it.

Mr. Whiteaves has also supplied me with a fragment of the original specimen described from the Guelph Limestones (Niagara Group) of Canada by Sir J. W. Dawson under the name of *Cœnostroma galtense* ('Life's Dawn on Earth,' p. 160, 1875, and 'Quart. Journ. Geol. Soc.,' vol. xxxv, p. 52, 1879). The minute structure of this specimen is practically destroyed by dolomitisation, but all its general characters would lead to the belief that it is very closely related to *S. typica*, Rosen, and is probably absolutely identical with it.

Prof. J. W. Spencer has kindly supplied me with a fragment of the species which he described from the Niagara Limestone of North America under the name of *Cœnostroma constellatum* ('Niagara Fossils,' p. 48, pl. vi, fig. 11, 1884). The minute structure of this is also almost wholly destroyed by dolomitisation; but it does not appear to be in any way distinguishable as regards its general characters from *Cœnostroma galtense*, Dawson, and I am strongly disposed to think that it is really identical with *S. typica*, Rosen.

If the above view should prove to be correct, then *Cœnostroma galtense*, Dawson, and *C. constellatum*, Spencer, must be considered as synonyms of *S. typica*, Rosen. Prof. Spencer, however, identifies his species with the previously described *Stromatopora constellata* of Hall ('Pal. N. Y.,' vol. ii, p. 324, pl. lxxii, fig. 2 *a*, *b*, 1852). If the identity of this last with *S. typica*, Rosen, should also be proved, then Hall's name should, strictly speaking, have precedence over that of Rosen. The real nature of Hall's *Stromatopora constellata* could, however, be established only by an investigation of the original specimen, if even then; since the brief description, with its accompanying figures, is not sufficient to establish clearly so much as the generic position of the fossil. Under these circumstances it would appear unreasonable to abandon the name of *S. typica* for that of *S. constellata*, even were the identity of the two to be ultimately proved; since Rosen based his species upon well-preserved specimens, and illustrated its characters by admirable and thoroughly recognisable figures.

Distribution.—*Stromatopora typica*, Rosen, appears to be wholly confined to the Silurian (Upper Silurian) Rocks, of which it is by far the commonest and most characteristic Stromatoporoid. No Ordovician or Devonian examples of the species are known. The species is, in fact, an essentially Wenlock type, and has an extremely wide distribution in space. In the Wenlock Limestone of Britain

the species is extremely abundant, occurring in numerous localities, as, for example, at Ironbridge, Dudley, Dormington, Longhope, and Much Wenlock. It is also a common form in the Wenlock Limestone of Gotland, though most of the specimens I have seen from this region are more or less altered by crystallisation. In Esthonia, in the Upper Oesel formation, it occurs plentifully, specimens being abundant at Lode (near Arensburg), Kaugatoma-pank, Kattri-pank, or Hoheneichen, all in Oesel. It also occurs in the Drift in Northern Germany. If I am right in regarding *Cœnostroma galtense*, Dawson, and *S. constellatum*, Spencer, as identical with *S. typica*, Rosen, then the species occurs in the Silurian Rocks of North America as well as in Europe.

3. Stromatopora Carteri, n. sp. Pl. I, figs. 6 and 7; and Pl. XXIII, figs. 1—3.

The cœnosteum in this species is of considerable size, massive, irregular in shape, and composed of gently undulated or curved latilaminæ (Plate XXIII, fig. 1), which vary from 2 to 4 or 5 mm. in thickness in their central portion. The under surface and mode of attachment are not known, but the upper surface is without distinct eminences or "mamelons," and shows simply an irregular vermiculate tuberculation. Astrorhizæ are not developed in any recognisable form.

As regards internal structure, the skeleton-fibre is about $\frac{1}{6}$ mm. in diameter, and is coarsely porous (Plate I, figs. 6 and 7). Vertical sections (Plate XXIII, fig. 2) show that each latilamina is composed of very distinctly developed radial pillars, which are separated from one another by equally distinct zoöidal tubes, and which really run continuously from the bottom to the top of each latilamina; though they appear to be more or less broken up, if—as in the example figured—the plane of the section is slightly oblique. About seven radial pillars, with their intervening zoöidal tubes, occupy a space of 2 mm., measured transversely. The zoöidal tubes are furnished with a moderate number of well-developed transverse partitions or "tabulæ." The radial pillars are connected at varying intervals by irregular horizontal or oblique processes, but these do not give rise to distinct "concentric laminæ," and the skeleton thus forms a loose and open reticulation, in which the vertical elements are far more conspicuous than the horizontal. As a result of this, tangential sections (Plate XXIII, fig. 3) show the cut ends of the radial pillars, either as separate structures, or, more usually, as united by the irregular horizontal processes above spoken of in such a way as to give rise to vermiculate and sinuous rows, which inosculate with one another and form a lax network.

Obs.—The specimens upon which I have founded this species, though mode-

rately numerous, are all more or less imperfect, none of them showing the base or mode of attachment. The species grows to a large size, and the cœnosteum is of the massive as distinguished from the laminar or discoidal type, the under surface having very possibly been devoid of an epithecal membrane. Latilaminar growth is a very marked feature, and each latilamina, as is the case in *S. typica*, Rosen, consists essentially of a single stratum of radial pillars which extend continuously from its lower to its upper surface, and are united by irregular horizontal or oblique connecting processes, these latter not being sufficiently regular to give rise in vertical sections to the appearance of definite "concentric laminæ." The skeleton-fibre in *S. Carteri* is of medium thickness, being finer than that of *S. concentrica*, Goldf., *S. Hüpschii*, Barg., or *S. discoidea*, Lonsd., but is remarkable for its coarsely porous structure, as seen in thin sections (Plate I, figs. 6 and 7). A characteristic feature is the peculiarly loose and open nature of the reticulated cœnosteal tissue (Plate XXIII, figs. 2 and 3). Another characteristic feature is the total or almost total absence of the branched and radiating astrorhizal canals, which are so conspicuous in most species of *Stromatopora*. In most examples of the present form no traces whatever of these structures can be detected, and in none are these more than the merest indications of their existence. The surface, therefore, is simply smooth or gently undulated, and is entirely without "mamelons."

I am not acquainted with any undoubted varietal forms of this species, nor have I ever seen a specimen of it in the "Caunopora-state."

S. Carteri cannot easily be confounded with any other species of the genus *Stromatopora*. It agrees with *S. typica*, Rosen, and with *S. concentrica*, Goldf., in its conspicuously latilaminar mode of growth; but it is distinguished from both these forms by the peculiar character of the skeletal reticulation, as also by the absence of astrorhizæ. By this last feature it is equally distinguished from *S. Hüpschii*, Barg., *S. Beuthii*, Barg., and *S. discoidea*, Lonsd., while it is further separated from these by the composition of its skeleton out of regular latilaminæ. The only species of *Stromatopora* with which *S. Carteri*, Nich., is really closely allied is a form from the Silurian Rocks (Upper-Oesel group) of Oesel, which I may provisionally name *S. borealis*. The general structure of the skeleton-fibre and of the cœnosteal tissue is the same in these two types, a distinct relationship, or, perhaps, an actual identity, being thus indicated. *S. borealis*, Nich., is, however, distinguished from *S. Carteri* by the fact that the cœnosteum of the former has the shape of a thin extended lamina, with a basal epitheca, while it is not composed of successively superimposed latilaminæ. The astrorhizal system of *S. borealis* is, moreover, very well developed. A further point of distinction is found in the fact that the zoöidal tubes of *S. borealis* are more abundantly furnished with tabulæ than is the case in *S. Carteri*, while these

structures are often placed at the same level in adjoining tubes, thus giving rise to the appearance of successive continuous concentric lines.

Distribution.—*S. Carteri*, so far as known, is entirely confined to the Wenlock Limestone of Britain; and my specimens have been principally obtained from the single locality of Ironbridge, in Shropshire, where the species is not altogether uncommon, though vastly more rare than is *S. typica*, Rosen. The species has not hitherto been certainly recognised in the Silurian Rocks of Gotland or Esthonia. Mr. Whiteaves has submitted to me for examination a fragment of a species of *Stromatopora*, obtained from a loose boulder on the banks of the Hayes River, in Hudson's Bay Territory, which very closely approaches in its characters to *S. Carteri*, though my material is not sufficient to justify me in asserting that it is absolutely identical with the latter.

4. STROMATOPORA HÜPSCHII, *Bargatzky* sp. Pl. X, figs. 8 and 9; Pl. XXII, figs. 3—7.

? STROMATOPORA POLYMORPHA, *Phillips*. Palæozoic Fossils of Cornwall, &c., p. 18, pl. x, fig. 27, 1841. (Non *Stromatopora polymorpha*, Goldfuss.)

?? CAUNOPORA PLACENTA, *Phillips*. Ibid., p. 18, pl. x, fig. 29.

— — *Bargatzky*. Die Stromatoporen des rheinischen Devons, p. 61, 1881.

— HÜPSCHII, *Bargatzky*. Ibid., p. 62, 1881.

STROMATOPORA BEUTHII, *Maurer*. Die Fauna der Kalke von Waldgirmes bei Giessen, p. 113, Taf. iii, fig. 5, 1885. (Non *Stromatopora Beuthii*, Bargatzky.)

— INDUBIA, *Maurer*. Ibid., p. 111, Taf. iii, figs. 1—3.

? — MACULOSA, *Maurer*. Ibid., p. 114, Taf. iii, figs. 6 and 7.

— HÜPSCHII, *Nicholson*. Monogr. Brit. Strom., General Introduction, fig. 6, A, B, and pl. x, figs. 8 and 9 (figured but not described).

The cœnosteum in this species is generally laminar, with a basal epitheca, but it is sometimes massive or irregular in form. Laminar examples vary in thickness from half a centimètre (young forms) to four or five centimètres, and when fully grown are often more or less cake-like in shape.

Latilaminæ are not at all, or very imperfectly, developed, though, as in most Stromatoporoids, traces of periodic intermissions of growth can be recognised. The "concentric laminæ," so far as such can be said to exist, are approximately straight, or are gently curved; and the surface is, therefore, devoid of "mamelons," at any rate in the typical form of the species. When well preserved, the

surface (Plate XXII, fig. 6) exhibits coarse vermiculate ridges, which inosculate with one another so as to form a network corresponding with the reticulated skeleton, while the elongated or rounded meshes correspond with the apertures of the zöoidal tubes. The surface also shows numerous astrorhizæ of a characteristic ramified type, which vary in size and distance, but usually have their centres about a centimètre apart.

As regards internal structure, the skeleton-fibre (Fig. 20, A and B) is coarsely porous, and is unusually stout (about $\frac{1}{4}$ mm. in diameter, or rather more). The cœnosteal tissue is of the completely "reticulate" type, the radial pillars and the trabeculæ of the "concentric laminæ" being fused into a continuous network. Vertical sections (Plate XXII, fig. 3), however, show that the radial pillars exist as distinct structures, united at irregular intervals by horizontal or oblique connecting-processes, and separated from one another by very well-developed zoöidal

FIG. 20.

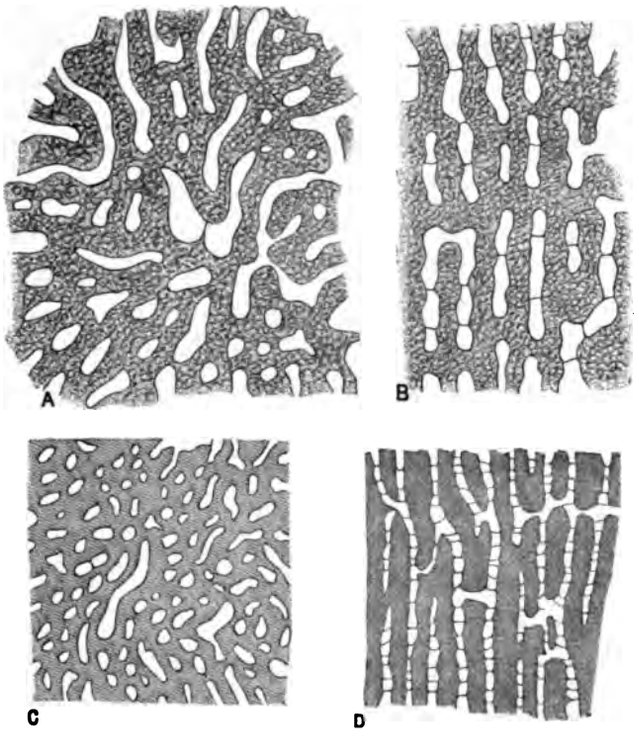


FIG. 20.—A. Tangential section of *Stromatopora Hüpschii*, enlarged twelve times, showing the reticulate skeleton and the porous skeleton-fibre. B. Vertical section of the same, similarly enlarged, showing the tabulate zoöidal tubes. C and D. Tangential and vertical sections of *Stromatopora Bücheliensis*, similarly enlarged. Middle Devonian.

tubes (Fig. 20, B), which are intersected by occasional remote tabulæ. About five radial pillars, with their intervening zoöidal tubes, occupy the space of two millimètres measured transversely. Tangential sections (Plate XXII, fig. 4, and woodcut, Fig. 20, A) show the loosely-woven and coarse network of the reticulated

skeleton, in which no traces of the radial pillars (as distinct structures) are recognisable. The apertures in this network correspond with the zoöidal tubes, and some of these are simply circular, while others are confluent, and thus give rise to elongated and sinuous meshes.

Obs.—The general form of the cœnosteum in this species is that of a thick lamina or cake, with an inferior epithecal membrane. Some examples, however, are massive in growth and irregular in form, and may not have possessed an epitheca. The upper surface is devoid of elevations, though it is probable that pointed prominences or "mamelons" corresponding with the astrorhizæ were present in the variety of the species which I shall term *S. Hüpschii*, var. *seposita*. Latilaminar growth is not clearly recognisable, as a rule, and the general skeletal structure is very characteristic. The skeleton-fibre (Fig. 20, A) is coarsely porous, and is unusually thick, the general cœnosteal reticulation being loose, with usually elongated and sinuous meshes. The zoöidal tubes, as seen in vertical sections (Fig. 20, B), are very clearly developed, but they show comparatively few tabulæ, or they may be even devoid of these structures.

Astrorhizæ (Plate XXII, fig. 5) are very abundantly developed, but are usually of small size, while they melt away rapidly at their circumference into the general reticulated tissue of the skeleton. In that form of the species which I propose to call *S. Hüpschii*, var. *seposita*, the astrorhizæ are superimposed in regular vertical systems, which are surrounded by concentrically disposed laminæ, penetrated more or less transversely by the radial pillars, thus giving rise to regular "astrorhizal cylinders." The spaces between these cylinders may be simply filled by loose reticulated tissue of the type ordinarily characteristic of this species, or may be occupied by undulated laminæ in a manner similar to what occurs in *Actinostroma verrucosum*, Goldf. sp. (figured in Plate XVI, fig. 1). It is probable that in this variety of *S. Hüpschii* each astrorhizal cylinder would project above the upper surface of the cœnosteum as a pointed "mamelon;" but none of my examples exhibit the general form or exterior. In its minute structure *S. Hüpschii*, var. *seposita* shows nothing to distinguish it from the normal form of the species.

Stromatopora Hüpschii very commonly occurs in the "Caunopora-state." It is, indeed, comparatively rare to meet with an example of this species which is *not* penetrated by "Caunopora-tubes." Such tubes vary considerably in size in different examples, but they can be commonly shown to possess funnel-shaped tabulæ in their interior (Plate X, fig. 9), and they sometimes possess radiating septal spines in addition. In some specimens, the "Caunopora-tubes" are short, and give off numerous lateral stolons, reminding one of an *Aulopora*-colony. In other cases, the tubes are straight, regularly parallel, and continuous throughout considerable vertical distances, thus reminding one rather of a *Syringopora*-colony.

I have figured a characteristic example of this latter type from the Devonian Limestone of Dartington, in which the tubes are exposed to view as the result of weathering (Plate XXII, fig. 7).

The species with which *S. Hüpschii* is most nearly allied is undoubtedly *S. Beuthii*, Barg., with which it agrees in the coarsely porous, stout skeleton-fibre, as also in the general type of reticulation of the cœnosteal tissue. *Well-preserved* examples of *S. Beuthii* are readily distinguished from *S. Hüpschii* by the fact that the radial pillars are so far persistent as to be quite recognisable as distinct structures; whereas in the latter the radial pillars have lost their axial canals, and are thus irrecognisably incorporated with the general skeletal reticulation. Hence, in tangential sections of *S. Beuthii* (Plate XXIII, figs. 10 and 12) the cut ends of the radial pillars are seen within the general cœnosteal network as distinct, circular, dark or light spaces, usually with a central dot representing the axial canal of the pillar; and even in vertical sections the axes of the pillars may be more or less clearly recognisable; whereas no such phenomena are observable in sections of *S. Hüpschii*. It must be admitted, however, that this distinction cannot always be made out in practice, since in badly-preserved specimens of *S. Beuthii* all traces of the persistent axes of the radial pillars may apparently be lost. Under such circumstances, examples of *S. Beuthii* can be distinguished from those of *S. Hüpschii* only by the comparatively uncertain tests that the general reticulation of the skeleton in the former is not so lax as in the latter; the radial elements of the cœnosteum are of stouter build than in *S. Hüpschii*, and are more clearly separated from the horizontal elements; while the zoöidal tubes are more abundantly tabulate, and the astrorhizæ are much less developed than is the case in the latter species.

From *S. concentrica*, Goldf., the present species is distinguished by its somewhat coarser skeleton-fibre, the much looser and more open character of the reticulated skeleton, the less perfect circumscription of the astrorhizæ, and the fact that growth of the cœnosteum is not effected by distinct latilaminæ.

As regards the *synonymy* of the present species, it seems very probable, judging from the figures given, that the fossils described by Phillips from the Devonian Limestones of Dartington and Chudleigh as *Stromatopora polymorpha*, Goldf. (loc. cit. supra) are really referable to *S. Hüpschii*, Barg.; but this cannot be asserted positively without an examination of the original specimens. In any case, the point is one of comparatively small interest, since I have shown (p. 4) that *Stromatopora polymorpha*, Goldf., probably covered three distinct forms, and that this specific name is therefore not worthy of retention. It also seems by no means improbable that the *Caunopora placenta* of Phillips (loc. cit. supra) was based upon a specimen of *Stromatopora Hüpschii* in the "Caunopora-state." This is a point of considerable importance, since if this could be established with

certainty, the specific name given by Phillips would, strictly speaking, have a claim to be retained, and the species would stand as *Stromatopora placenta*, Phill. sp. Upon full consideration, however, I have decided to retain Bargatzky's name for this species upon two grounds—viz. in the first place, that the description and figures given by Phillips of his *Caunopora placenta* are entirely insufficient to determine clearly the form which he had under consideration, and, in the second place, that the "Caunopora-tubes" are made an essential part of the diagnosis of the species. If the original specimen of Phillips were examined, it is very possible that it might prove to be referable to what is here understood as *Stromatopora Hüpschii*, Barg. It might, however, prove to be a "Caunoporised" example of *S. Beuthii*, Barg., or *S. Bücheliensis*, Barg., and, indeed, I am rather disposed to think that it is to the last-named of these that it really belongs. At any rate, the original figures and descriptions would fit the one hypothesis quite as well as the other; and under these circumstances it seems to me best to allow the name of *Caunopora placenta*, Phill., to fall altogether.

On the other hand, the *Caunopora placenta* of Bargatzky himself—as I have established by an examination of the original specimens—is really identical with the *Caunopora Hüpschii* of the same author; and in order to avoid confusion with the fossil described by Phillips as *C. placenta*, the second of Bargatzky's specific titles must be retained. As I have shown previously, however, Bargatzky was led into a misconception of the true nature of the genus *Stromatopora* by reason of his ignorance of the minute structure of *S. concentrica*, Goldf., the type-species of this genus. The *Stromatopora* of Bargatzky is thus really what I have named *Actinostroma*, and the *Caunopora* of this author is really *Stromatopora*. The present species, therefore, under the circumstances just recounted, may best stand as *Stromatopora Hüpschii*, Barg. sp.

The *Stromatopora Beuthii* of Maurer (loc. cit. supra) appears to be founded upon a specimen of *S. Hüpschii*, Barg., *without* "Caunopora-tubes," while the *S. indubia* of the same author seems to be *S. Hüpschii with* "Caunopora-tubes." The *S. maculosa* of Maurer may also be referable to *S. Hüpschii*, but its preservation is bad, and its true affinities are doubtful.

Distribution.—*S. Hüpschii*, Barg., appears to be entirely confined to the Devonian Rocks, occurring with great frequency in the Middle Devonian Limestones of both Britain and Germany. In the latter region it occurs abundantly at Büchel, in the Paffrath District, but appears to be wanting at Hebborn (where *S. Beuthii*, Barg., is common), while it is a rare species at Gerolstein. In the Devonian Limestones of Devonshire it is the commonest of all the forms of *Stromatopora*, occurring usually in the "Caunopora-state." Large and perfect examples are found at Dartington (Pit-Park Quarry), while others are found at Bishopsteignton, and the species is exceedingly abundant in the pebbles of

Devonian Limestone in the Triassic conglomerates of Teignmouth. *S. Hüpschii*, var. *seposita*, Nich., occurs not very uncommonly at Teignmouth.

5. STROMATOPORA INÆQUALIS, n. sp. Pl. XXIV, figs. 11 and 12.

The form, size, and surface-characters of this species are unknown, as also is the mode of attachment of the organism. The mode of growth is continuous, and not by latilaminæ. The skeleton-fibre is thick and coarsely porous, and is woven into a loose reticulation, the meshes of which are elongated and sinuous, the general characters of the cœnosteal tissue agreeing in all essential respects with those distinctive of *S. Hüpschii*, Barg. Vertical sections show that the radial pillars are well developed, while numerous distinct zoöidal tubes, intersected by a moderately large number of transverse partitions or "tabulæ," are present. The astrorhizæ are exceedingly well developed, and exhibit a distinct division into two series, a larger and smaller, which are regularly intermingled with one another (Plate XXIV, figs. 11 and 12). The larger astrorhizæ have a few slightly divided branches, their centres being placed from 6 to 12 mm. apart. The smaller astrorhizæ consist of numerous short, hardly divided, radiating canals, and occupy the interspaces between the larger ones.

Obs.—This species is only known to me by polished specimens obtained from the Devonian pebbles in the Triassic conglomerates of Teignmouth, and these show nothing as to the general form or mode of attachment of the cœnosteum. Moreover, almost all the specimens I have examined are in the "reversed" condition, the actual skeleton being more or less extensively replaced by calcite, while the astrorhizal canals and zoöidal tubes are more or less completely infiltrated with opaque calcareous mud. I have only obtained one specimen in which the state of preservation of the skeleton is normal. This specimen shows that, as regards general internal structure, there is nothing that would clearly distinguish *S. inæqualis*, Nich., from *S. Hüpschii*, Barg., and it is possible that the former is only a well-marked variety of the latter. The apparently constant division of the astrorhizæ in *S. inæqualis* into two series of different sizes and shapes is, however, so marked a feature (Plate XXIV, figs. 11 and 12), that it seems to me advisable to consider this form as a distinct species. If the character in question be admitted as of specific value, then there is no other species of the genus *Stromatopora* with which the present form could be confounded.

Distribution.—*S. inæqualis* is of rare occurrence in the pebbles of Devonian Limestone in the Triassic conglomerates of Teignmouth.

6. STROMATOPORA FLORIGERA, n. sp. Pl. XXII, figs. 8—10.

The form, size, and mode of growth of the cœnosteum in this species are unknown. The cœnosteal tissue is not developed in latilaminæ, and is completely reticulated (Plate XXII, fig. 9), the skeleton-fibre being coarsely porous in structure, and having an average diameter of from $\frac{1}{5}$ to $\frac{1}{6}$ mm. The astrorhizæ are exceedingly numerous and are of small size, their centres being in general about 4 mm. apart (Plate XXII, fig. 8). The astrorhizæ are developed in vertically superimposed rows, each system being traversed by an axial wall-less canal; but proper "astrorhizal cylinders" are not usually developed. From the condition of the astrorhizæ it may be inferred that the surface exhibited close-set conical "mamelons" corresponding with the centres of the astrorhizal systems. Tangential sections (Plate XXII, fig. 9) show the completely reticulate character of the general skeleton, into which the minute astrorhizæ melt insensibly at their edges. Vertical sections (Plate XXII, fig. 10) show that the radial pillars are clearly recognisable, and that well-developed zoöidal tubes, traversed by numerous transverse partitions or "tabulæ" are present. Such sections also commonly exhibit the axial canals of the astrorhizal systems. About six zoöidal tubes, with their intervening pillars, occupy a space of 2 mm. measured transversely.

Obs.—This species is of the same general type as *S. Hüpschii*, Barg., from which it is chiefly distinguished by the more delicate character of the skeleton-fibre, the much smaller size and greater proportionate number of the astrorhizæ, and the fact that these structures are developed in regular vertical systems. From *S. Hüpschii*, var. *sepositа*, Nich., in which the astrorhizæ are also developed in vertical systems, *S. florigera* is separated by its more delicate texture, the much more closely-set astrorhizæ, and the fact that astrorhizal cylinders are usually wanting. The zoöidal tubes of *S. florigera* are also furnished with more numerous tabulæ than is the case with those of *S. Hupschii*, Barg. There is no other species of the genus *Stromatopora* with which the present form could well be confounded. My material of *S. florigera* is, unfortunately, very limited, and I am unable to give any information as to the general form of the cœnosteum or the condition of its surface. I have seen no specimens in the "Caunopora-state," but examples occasionally occur in the "reversed" condition.

Distribution.—This species is only known to me as occurring rarely in the pebbles of Devonian Limestone in the Triassic conglomerates of Teignmouth.

7. STROMATOPORA BEUTHII, *Bargatzky*. Pl. V, figs. 12, 13; Pl. XXIII, figs. 8—13; and Pl. XXIV, fig. 1.

STROMATOPORA BEUTHII, *Bargatzky*. Die Stromatoporen des rheinischen Devons, p. 56, 1881.

? — TURGIDECOLUMNATA, *Maurer*. Die Fauna der Kalke von Waldgirmes, p. 112, Taf. iii, fig. 4, 1885.

— BEUTHII, *Nicholson*. Monogr. Brit. Strom., General Introduction, pl. v, figs. 12 and 13, 1886 (figured but not described).

The cœnosteum of this species is massive, and often attains a considerable size, an imperfectly developed latilaminar structure being in some instances recognisable. The cœnosteum is apparently fixed by a small portion of the inferior surface, a basal epitheca being absent. The concentric laminæ are simply curved, and the surface is therefore free from "mamelons," and merely exhibits a coarse vermicular reticulation corresponding with the skeletal framework, and pierced by rounded or sinuous apertures representing the mouths of the zoöidal tubes. Astrorhizæ are absent, or are irregularly and imperfectly developed.

The skeleton-fibre is about $\frac{1}{4}$ mm. in diameter, and has a coarsely porous structure (Fig. 21, A—C). The general skeletal tissue is of the reticulated type (Plate XXIII, figs. 10 to 12), but the radial pillars retain their individual distinctness to an extent not seen in any other species of *Stromatopora*. As a rule, the axial canals of the radial pillars are persistent, and the cut ends of these structures can be recognised in thin tangential sections (Plate V, fig. 12; and Plate XXIII, figs. 10 and 12) as rounded dark or light spaces, sometimes with a dark central dot, immersed in the substance of the general cœnosteal mesh. Vertical sections (Plate V, fig. 13; and Plate XXIII, fig. 11) also exhibit very distinct radial pillars, the axial canals of which are likewise occasionally recognisable in well-preserved examples (Plate V, fig. 13). The zoöidal tubes are very well developed, and are intersected by numerous thick and complete horizontal partitions or "tabulæ" (Plate V, fig. 13; and Plate XXIII, fig. 11). Three or four zoöidal tubes, with their intervening pillars, occupy a space of 2 mm. measured transversely.

Obs.—The cœnosteum of *S. Beuthii*, Barg., is usually hemispherical or spheroidal in shape, and is often of large size. The characteristic surface-features of the species are the coarse superficial reticulation, the want of "mamelons," and the more or less complete absence of astrorhizæ. A few examples apparently referable to this species do, however, exhibit astrorhizæ; but these are few in

number and are irregularly developed. In its coarsely porous and very stout skeleton-fibre (Fig. 21), as also in the general character of the cœnosteal network, *S. Beuthii* closely approaches *S. Hüpschii*, Barg.; but the skeletal mesh is of a closer and less lax type, while the latter species has also a largely developed astrorhizal system. The essentially distinctive feature of *S. Beuthii*, however, is to be found in the condition of the radial pillars, these structures being, in good specimens, readily recognisable as separate from the general cœnosteal tissue in which they are immersed. As a result of this, polished horizontal or vertical slices of *S. Beuthii* (Plate XXIII, figs. 8 and 9) have a close general resemblance to corresponding slices of such a species of *Actinostroma* as *A. fenestratum*, Nich. Vertical slices, in particular, very nearly resemble similar sections of an *Actinostroma*, the radial pillars in such sections constituting an extremely

FIG. 21.

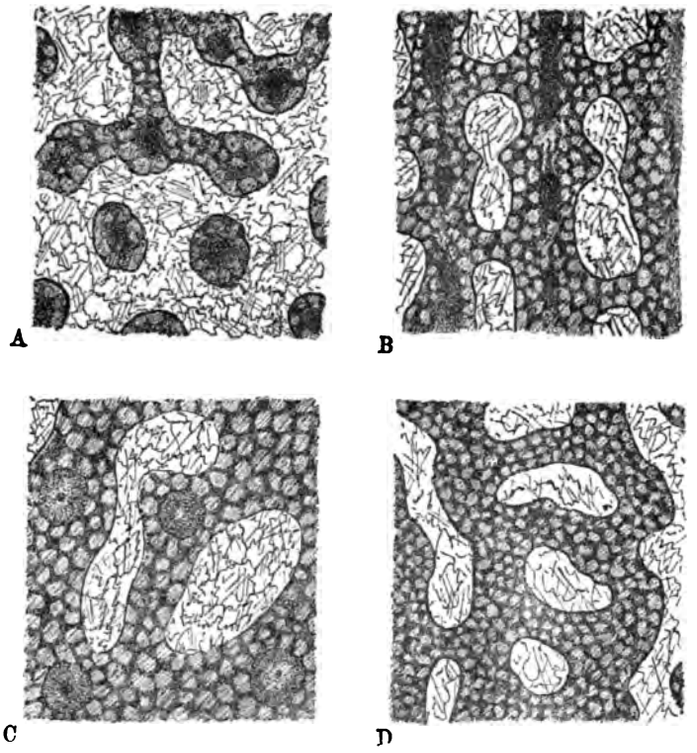


FIG. 21.—A. Tangential section of a specimen of *Stromatopora Beuthii*, Barg., from the Middle Devonian of Büchel, showing the axes of the persistent radial pillars as dark spaces in the general network. B. Vertical section of the same specimen. C. Tangential section of another specimen of *S. Beuthii*, from the Middle Devonian of Hebborn, showing clearly defined cross-sections of the radial pillars immersed in the general reticulation. D. Tangential section of a specimen of *S. Hüpschii*, Barg., from the Middle Devonian of Büchel, showing the complete disappearance of the radial pillars as separate structures. All the figures are enlarged about 30 times.

marked feature. On the other hand, thin sections (Fig. 21) show that the radial pillars, though apparently so distinct, are really buried in the interior of the

Triassic conglomerates of Teignmouth. In Germany the species is tolerably abundant in the Middle Devonian Limestones of Hebborn and Büchel in the Paffrath district. A single poorly preserved example, which I collected at Gerolstein, differs from the ordinary form of the species in having a laminar cœnosteum.

8. Stromatopora Bücheliensis, *Bargatzky* sp. Pl. X, figs. 5—7, and Pl. XXIII, figs. 4—7.

Caunopora bücheliensis, *Bargatzky*. Die Stromatoporen des rheinischen Devons, p. 62, 1881.

Stromatopora bücheliensis, *Nicholson*. Monogr. Brit. Strom., General Introduction, p. 23, pl. x, figs. 5—7, 1886 (figured but not described).

The cœnosteum in this species is very variable in form, being mostly either massive or lobate, but being sometimes composed of slender cylinders united in bundles, or being in rare cases laminar in shape. A basal epitheca is present in the laminar examples, as, probably, in the massive specimens also.

Most specimens show a more or less distinct zonal mode of growth, the successive zones or strata of the cœnosteum hardly assuming the character of proper "latilaminæ," since they are directly continuous with one another, and thus mark but incomplete intermissions of growth.

Whatever may be the form of the cœnosteum, the concentric laminæ are simply curved, and "astrorhizal cylinders" are not developed, the surface being thus free from "mamelons." The surface shows a minute reticulation, the rounded or oval pores of which represent the apertures of the zoöidal tubes. Astrorhizæ are numerous, but are of small size, with few branches, their centres being usually placed at distances of 10 mm. or more apart.

The skeleton-fibre is minutely porous, and has a diameter of $\frac{1}{8}$ or $\frac{1}{9}$ mm. The cœnosteal tissue is of the reticulate type (Plate XXIII, fig. 7; and woodcut, Fig. 20, c), the radial pillars being united into a continuous network by horizontal or oblique bars of the same thickness as themselves. As seen in cross-sections, the cœnosteal mesh is close, with narrow and often sinuous interspaces representing the transversely divided zoöidal tubes. Vertical sections (Plate XXIII, fig. 6; and woodcut, Fig. 20, d) show that the radial pillars are distinctly recognisable, and that the cœnosteum is traversed by numerous narrow zoöidal tubes which are abundantly furnished with cross-partitions or "tabulæ." About seven zoöidal tubes, with their intervening pillars, occupy a space of 2 mm. measured transversely.

Obs.—The cœnosteum of *S. Bücheliensis*, Barg., is mostly of a lobate or sub-

and the digitated variety occur commonly in the Middle Devonian Limestones of Dartington (Pit-Park Quarry), and are found abundantly in the Devonian pebbles of the Triassic conglomerates at Teignmouth. In Germany the species is not uncommon in the Middle Devonian Limestone of Büchel, in the Paffrath district, most examples from this locality being lobate in form. The species does not seem to occur at Hebborn, in the same district, and is of rare occurrence at Gerolstein, in the Eifel.

9. STROMATOPORA DISCOIDEA, *Lonsd.* sp. Pl. III, fig. 3; Pl. VII, figs. 1 and 2; and Pl. XXIV, figs. 2—8.

PORITES DISCOIDEA, *Lonsdale.* Silurian System, p. 688, pl. xvi, fig. 1, 1839.
HELIOLITES? DISCOIDEUS, *Salter.* In Murchison's Siluria, 3rd ed., pl. xxxix, fig. 1, 1859.
STROMATOPORA ELEGANS, *von Rosen.* Ueber die Natur der Stromatoporen, p. 63, Taf. ii, fig. 8, and Taf. iii, figs. 1 and 2, 1867. (Non *Stromatopora elegans*, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. iv, 1879.)
CŒNOSTROMA DISCOIDEUM, *Lindström.* Kongl. Svenska Vetenskaps-Akad. Handlingar, Bd. ix, Taf. i, figs. 6 and 7, 1870.
STROMATOPORA DISCOIDEA, *Nicholson.* Monogr. Brit. Strom., General Introduction, pl. iii, fig. 3, and pl. vii, figs. 1 and 2, 1886 (figured but not described).

The cœnosteum of this species is essentially of the laminar or expanded type, and usually has the form of a thinner or thicker disc, attached by a portion of the base to some foreign body, and having the rest of the under surface covered with a concentrically wrinkled or striated epithecal membrane. In some cases, while the same general form is retained, the cœnosteum is so thickened as to assume a hemispherical shape, the base remaining flat or concave. In the thinner examples growth of the skeleton is continuous, but in the thicker examples more or less regular "latilaminæ" are observable, indicating periodic pauses in the process of growth.

The concentric laminæ are simply undulated, and the surface is therefore free from eminences or "mamelons." Astrorhizæ are extraordinarily developed, being not only very numerous, but being of an excessively ramified or arborescent type (Plate III, fig. 3; and Plate XXIV, fig. 2). The astrorhizæ vary in size in different individuals, their centres being usually from 5 to 7 mm. apart; but in all cases they become more or less completely confluent with one another by the

the species of *Stromatopora*, and it is not an unusual thing to find that part of a thin section may have the pores simply filled with clear calcite, and therefore appearing as rounded vacuities, while another portion of the same has the pores infiltrated with opaque material, and appearing as dark spots. The skeleton-fibre of *S. discoidea* is, however, particularly prone to undergo change by mineralisation, and thin sections of altered specimens often show puzzling appearances. In Plate VII, figs. 1 and 2, I have figured thin sections of one of these partially decomposed specimens, in which the skeleton-fibre has assumed a minutely dotted appearance, but in which the characteristic features of the cœnosteum are still clearly recognisable. In more extreme cases, however, the minute structure of the skeleton becomes more or less extensively obliterated, and the diagnostic features of the species can with difficulty be recognised in thin sections, or may be wholly lost; and it is a curious fact that this highly mineralised condition of the cœnosteum is often found in specimens in which the preservation of the surface-characters may be exceedingly good. It is also to be noted that the most highly mineralised examples of *S. discoidea* yield thin sections which might readily be confounded with corresponding sections of altered examples of *Actinostroma astroites*, Rosen sp.

On the other hand, well-preserved specimens of *S. discoidea* yield thin sections which are quite characteristic. Tangential sections (Plate XXIV, fig. 6) show appearances closely conforming with those of the surface, the skeletal network having the form of numerous irregular islands of dense cœnosteal tissue, perforated by the minute openings of the transversely divided zoöidal tubes, and separated by branches of the astrorhizæ. Vertical sections (Plate XXIV, fig. 7) are characterised by the thick radial pillars, and by the presence of well-defined and abundantly tabulate zoöidal tubes.

S. discoidea often encrusts or envelops corals or other foreign bodies in the course of its growth, but I have never seen a specimen in the "Caunopora-state." Very commonly the cœnosteum contains embedded *Spirorbes*, which are often arranged in vertical rows, as they become successively immersed in the tissue of the growing Stromatoporoid.

From *S. typica*, Rosen—its nearest ally—as from all other recorded forms of *Stromatopora*, the present species is readily distinguished by the remarkable development of the astrorhizal system and the resulting characters of the surface, as also by the density and closeness of the cœnosteal network.

Having examined the original specimen of *S. elegans*, Rosen, as well as thin sections of the same, I am satisfied that this name is synonymous with *S. discoidea*, Lonsd. Von Rosen's specimen of *S. elegans* is, in fact, an example of *S. discoidea*, Lonsd., in which the skeleton has been largely altered by mineralisation, as shown in the tangential section which I have figured (Plate XXIV, fig. 8).

Distribution.—*S. discoidea*, Lonsd. sp., is entirely confined to the Silurian Rocks, and has hitherto been recognised only in the Wenlock Limestone of Britain, and in corresponding deposits in Northern Europe. In the Wenlock Limestone of England the species is moderately common, occurring at Ironbridge, Much Wenlock, and Dudley; but really well-preserved examples are rare. In the Wenlock Limestone of Wisby (Gotland) *S. discoidea* appears to be a common species, the specimens from this region being usually highly mineralised, but commonly having the surface well preserved. In Esthonia the species has hitherto been recognised only at the single locality of Kleine Ruhde, occurring in limestones belonging to the zone of *Pentamerus ehstonus*.

Genus 2.—PARALLELOPORA, *Bargatzky*, 1881.

(Introduction, p. 95.)

1. PARALLELOPORA GOLDFUSSII, *Bargatzky*. Pl. XI, figs. 7—9; and Pl. XXV, figs. 4—9. Woodcuts, figs. 22, 24, and 25.

PARALLELOPORA GOLDFUSSII, *Bargatzky*. Die Stromatoporen des rheinischen Devons, p. 63, 1881.

Cœnosteum irregularly spheroidal or clavate, from 2 to 7 cm. in diameter, with a limited basal attachment, and apparently devoid of an epitheca. The mode of growth is not distinctively latilaminar, and the concentric laminæ are simply curved, the surface being free from "mamelons." Where observed, the surface shows a moderately coarse reticulation, with oval, rounded, or vermiculate pores representing the mouths of the zoöidal tubes; or it may be partially covered by an apparently imperforate calcareous membrane.

Astrorhizæ are present, but are variably developed, being sometimes small and inconspicuous, and at other times composed of large, few-branched canals. In the latter case the astrorhizæ are exceedingly irregular in their distribution, being abundant in some specimens and nearly absent in others. The horizontal canals of the astrorhizæ are often furnished with oblique or transverse calcareous partitions ("astrorhizal tabulæ"); and are sometimes connected with comparatively large, rounded or oval internal cavities, which are scattered through the cœnosteum, and are also furnished with calcareous partitions or tabulæ. These cavities are not always present, and may possibly be connected with reproduction, thus representing the "ampullæ" of the Hydrocorallines.

As regards its internal structure, the skeleton-fibre of *Parallelopora Goldfussii*

is from $\frac{1}{6}$ to $\frac{1}{5}$ mm. in diameter, and has a peculiar porous or tubulated structure, which will be more fully described hereafter, but the most characteristic feature of which is the appearance, in thin sections, of isolated clear spaces of comparatively considerable size within the substance of the fibre (Plate XXV, figs. 4—7). The skeleton-fibre thus constituted is woven into an irregular network enclosing the vertical, straight or flexuous zoöidal tubes. In tangential sections (Plate XXV, fig. 4) this irregular reticulation is seen to be traversed by the scattered and commonly tabulate branches of the astrorhizæ, and pierced by the variably shaped apertures of the transversely divided zoöidal tubes. Vertical sections (Plate XXV, figs. 5 and 9) show that the cœnosteal tissue is composed of thick and irregular radial pillars united at intervals by thick horizontal or oblique connecting-processes, the network thus formed enclosing numerous zoöidal tubes, which are furnished with well-developed transverse tabulæ. About six zoöidal tubes, with their intervening pillars, occupy a space of 2 mm. measured transversely.

Obs.—The cœnosteum of *P. Goldfussii*, Barg., is typically spheroidal, pyriform, or clavate in shape (woodcut, Fig. 22), and is usually of small size. The

FIG. 22.

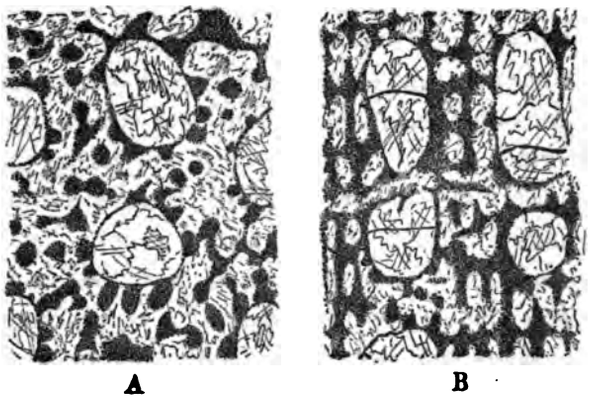
FIG. 22.—A small specimen of *Parallelopora Goldfussii*, Barg., from the Middle Devonian of Hebborn, viewed sideways; of the natural size.

specimens from the Middle Devonian Rocks of Hebborn (Paffrath district) are mostly stunted, being usually about 2 to 3 cm. in diameter; whereas those from Steinbreche near Refrath, in the same area, are of considerably larger size. There is no trace of an epitheca in such specimens as I have seen; and the cœnosteum often envelops corals and other foreign bodies. The specimens from Devonshire, being mostly derived from the Devonian pebbles in the Triassic breccias of that region, have no recognisable form as a rule; but a badly preserved example from Dartington, apparently referable to this species, has a massive cœnosteum of considerable size, with much-undulated laminæ.

The astrorhizal system is remarkably variable in its development in this species. Some examples show only very small and scattered astrorhizæ; but the typical state of things is to find irregularly distributed astrorhizæ consisting of a few slightly branched canals of large size, the internal cavities of these being

supposed minute cœnenchymal tubes of *P. ostiolata* can be detected in properly prepared thin sections. On the contrary, it is quite certain that the large tabulate zoöidal tubes of *P. ostiolata* are simply enclosed in a reticulated skeleton, the fibre

FIG. 23.



A B

FIG. 23.—A. Part of a tangential section of *Parallelopora ostiolata*, Barg., from the Middle Devonian Rocks of Büchel (Paffrath district), enlarged 80 times. B. Part of a vertical section of the same, similarly enlarged.

of which is traversed by dark and seemingly solid rods. It is quite probable that these apparent rods are really the result of the infiltration with opaque matter of a system of minute tubuli running in the interior of the reticulated skeleton-fibre; but it may be taken as altogether certain that such tubuli are part of the fibre itself, and are in no way comparable with the interstitial tubes (" mesopores ") of the Monticuliporoids or the " siphonopores " of the *Heliolitidæ*.

In *Parallelopora Goldfussii*, Barg., the appearances presented by the skeleton-fibre, as seen in thin sections, differ considerably from those shown by corresponding sections of *P. ostiolata*, though the differences observed may be largely the result of differences in the mode of preservation, and in the extent to which mineralisation has been carried. In a tangential section of a well-preserved specimen of *P. Goldfussii* (Plate XXV, fig. 4; and woodcut, Fig. 24) the skeleton-fibre is seen to be thick, and to be completely reticulated, while it exhibits in its substance numerous small round or oval spaces, which are filled with clear calcite, and thus look like the apertures of transversely divided tubuli. As the result of this, tangential sections acquire a characteristic perforate or cribriform appearance (Plate XXV, figs. 4 and 8), which differs from the uniformly porous aspect presented by corresponding sections of any species of *Stromatopora* proper in so far that the apparent pores in the fibre are few in number and comparatively large in size. *Vertical* sections of a well-preserved specimen of *P. Goldfussii* do not, however, show the presence in the fibre of regular vertical tubules, such as would be inferred to exist from the phenomena exhibited by tangential sections. On the contrary, such sections (Plate XXV,

figs. 5 and 7; and woodcut, Fig. 25) show that the skeleton-fibre is penetrated by clear round spaces or pores similar to those seen in tangential sections, while irregular branching canaliculi appear to be also present. The information

Fig. 24.

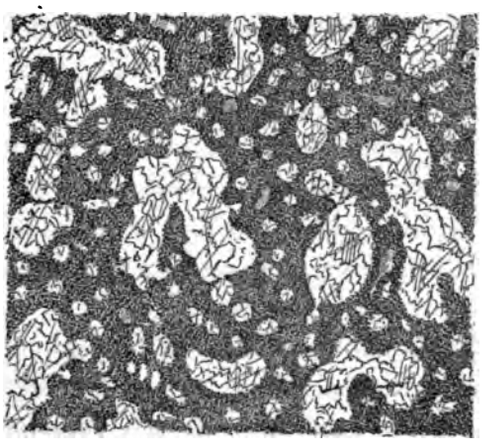


Fig. 24.—Part of a tangential section of a specimen of *Parallelopora Goldfussii*, Barg., from the Middle Devonian of Steinbreche (Paffrath district), enlarged 50 times.

Fig. 25.

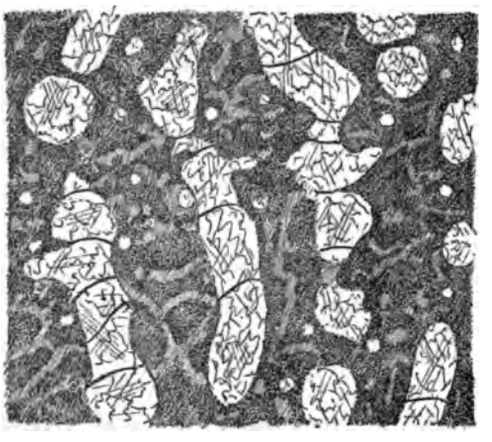


Fig. 25.—Part of a vertical section of the preceding specimen of *Parallelopora Goldfussii*, similarly enlarged.

derivable from both sets of sections would thus lead to the belief that the skeleton-fibre of *P. Goldfussii* is traversed by minute and irregular canals, together with moderately numerous vesicular cavities of comparatively large size. If this view be correct, then the structure of the skeleton-fibre in *Parallelopora Goldfussii* differs from that seen in *Stromatopora* or *Stromatoporella* in degree rather than in kind.

In certain states of preservation, however, the skeleton-fibre of *P. Goldfussii* presents appearances differing considerably from those described above. The skeleton-fibre, namely, often appears in tangential sections as if it were composed of nearly transparent calcite, in which are developed dark granular tracts which inosculate with one another to form an irregular open network or a close reticulation (Plate XI, fig. 7,[1] and Plate XXV, fig. 6). In vertical sections (Plate XXV, fig. 7) the fibre may show appearances very similar to those seen in tangential sections; or the dark tracts in the fibre may assume more or less of a ladder-like or trellis-like arrangement (Plate XI, fig. 8). In *Parallelopora capitata*, Goldf. sp., the appearances presented by the skeleton-fibre in thin sections are very similar to those shown by *P. Goldfussii*, Barg.; and in *P. dartingtonensis*, Cart. sp., there are indications that the fibre is similarly constituted, though none of my

[1] This figure (as also fig. 8 of the same plate) is doubtfully referred in the explanation of the plate to *Parallelopora (Idiostroma?) capitata*, Goldf., but it really belongs to the species here under consideration.

specimens are in a state of preservation suitable for the exhibition of the characters in question.

Upon the whole, it would appear that the genus *Parallelopora* is nearly allied to *Stromatopora*, but that it may be fairly separated from this by the structure of the skeleton-fibre. In *Stromatopora*, Goldf., the skeleton-fibre is minutely porous, being traversed throughout by innumerable small vacuities, which are closely contiguous. In *Parallelopora*, Barg., on the other hand, the thick fibre is penetrated by irregular canaliculi, and also contains a moderate number of comparatively large vacuities or pores, which are scattered through the fibre at intervals. As a result of this, tangential sections show a markedly perforate or cribriform character of the fibre, which can commonly be recognised in polished specimens even with a hand-lens, while vertical sections show a similarly perforate aspect, or may exhibit a lattice-like structure.

Putting aside the peculiar structure of the skeleton-fibre, thin sections of *Parallelopora Goldfussii*, Barg., nearly resemble in general type those of various species of *Stromatopora*. The zoöidal tubes are excavated in the reticulated cœnosteal tissue, and appear in cross-sections (Pl. XXV, fig. 4) as rounded or oval or sinuous perforations, while they are seen in long sections (Plate XXV, fig. 5) to be provided with numerous tabulæ. The radial pillars are wavy, but are approximately parallel, and are connected at irregular intervals by thick cross-bars.

In some instances (Plate XXV, figs. 8 and 9) *P. Goldfussii*, Barg., occurs in the "Caunopora-state," the "Caunopora-tubes" being furnished with funnel-shaped tabulæ.

From *P. capitata*, Goldf. sp., which it nearly resembles in general form, the present species is sufficiently distinguished by the much finer texture of the skeletal tissue and the smaller and more closely set zoöidal tubes. From *P. dartingtonensis*, Cart. sp., on the other hand, the present species is separated by its thicker skeleton-fibre, and particularly by the fact that the radial pillars are comparatively stout and irregular, whereas in the former these structures are narrow, close-set, and straight. Moreover, the cœnosteum in *P. Goldfussii* is comparatively small and is typically spheroidal in shape, while it is massive or laminar in *P. dartingtonensis*, and may attain a considerable size.

Distribution.—*Parallelopora Goldfussii*, Barg., is not uncommon in the Middle Devonian Limestones of the Paffrath district, occurring at Hebborn, Hand, and Steinbreche (near Refrath), the last locality in particular yielding excellent examples. In the Devonian Rocks of Devonshire the species occurs rarely in the pebbles of the Triassic conglomerates, and I have a single doubtful example from Dartington.

2. PARALLELOPORA CAPITATA, *Goldfuss* sp. Pl. XXV, figs. 10—13. Woodcuts, Figs. 26 and 27.

TRAGOS CAPITATUM, *Goldfuss*. Petrefacta Germaniæ, p. 13, Taf. v, fig. 6, 1826.
STROMATOPORA CAPITATA, *D'Orbigny*. Prodr. de Paléontologie, p. 51, 1850.
— CONCENTRICA, *Bargatzky* (pars). Die Stromatoporen des rheinischen Devons, p. 54, 1881.
IDIOSTROMA CAPITATUM? *Nicholson*. Monogr. Brit. Strom., General Introduction, p. 63, fig. 8, and p. 104, 1886.

The cœnosteum in this species is of the massive type, and is usually spheroidal or pyriform in shape (woodcut, Fig. 26), being attached by a small portion of its

FIG. 26.

FIG. 26.—Side view of a small specimen of *Parallelopora capitata*, Goldf. sp., from the Middle Devonian of Hebborn (Paffrath district), of the natural size.

under surface, and not having a basal epitheca. The cœnosteum did not attain a great size, most examples being from 2 to 6 cm. in diameter. Growth is not distinctly latilaminar, and the concentric laminæ are generally simply curved or undulated, the surface being thus approximately smooth or simply nodulated. When well preserved, the surface shows a coarse vermiculate reticulation, corresponding with the form of the skeletal network, along with large and irregularly distributed astrorhizal canals (woodcut, Fig. 26), but parts of the surface may be concealed beneath an apparently imperforate calcareous membrane.

Astrorhizæ are developed in an irregular manner, their tubes (woodcut, Fig. 27, *c c*) being of very large size, and furnished internally with numerous transverse calcareous partitions (" astrorhizal tabulæ "), which sometimes assume a subvesicular character (Plate XXV, fig. 10).

Sometimes connected with the astrorhizal tubes, or at other times independently scattered throughout the cœnosteal tissue, are large, lenticular, oval, or spherical vesicles, which are apparently destitute of proper walls, and are about a millimètre in average diameter. These vesicles are occasionally crossed by one

or more calcareous partitions, and may possibly be connected with reproduction, and may correspond with the ampullæ of the recent Stylasterids.

Fig. 27.

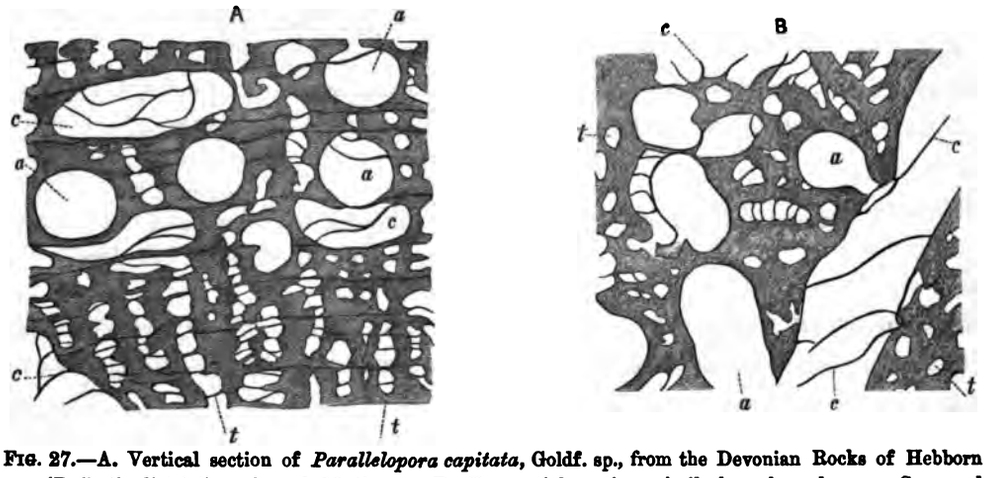


Fig. 27.—A. Vertical section of *Parallelopora capitata*, Goldf. sp., from the Devonian Rocks of Hebborn (Paffrath district), enlarged 12 times. B. Tangential section, similarly enlarged. *a a*. Supposed "ampullæ." *c c*. Large tabulate tubes belonging to the astrorhizæ. *t t*. The ordinary zoöidal tubes.

The skeleton-fibre is stout, and possesses a tubulated or perforate structure (Plate XXV, fig. 13), similar to that previously described in *P. Goldfussii*, Barg., though, owing to the imperfect state of preservation of the majority of specimens, this can only be clearly made out in an occasional example. The cœnosteal tissue, as seen in tangential sections (Plate XXV, figs. 10 and 11; and woodcut, Fig. 27, B), is irregularly reticulated, and is traversed by the irregularly distributed, tabulate astrorhizal canals, and by the apertures representing the transversely divided zoöidal tubes. As seen in vertical sections (Plate XXV, fig. 12; and woodcut, Fig. 27, A) the skeleton is composed of stout, approximately parallel radial pillars, which are connected at short intervals by thinner or thicker cross-bars, tolerably regular and close-set "concentric laminæ" being in this way sometimes developed. The radial pillars are separated by well-developed zoöidal tubes, which are intersected by numerous straight or curved "tabulæ." About four zoöidal tubes, with their intervening radial pillars, occupy the space of 2 mm. measured transversely. Vertical sections also show the large rounded apertures of the transversely divided astrorhizal tubes as well as the supposed "ampullæ" above spoken of, these structures communicating to such sections (Plate XXV, fig. 12; and woodcut, Fig. 27, A) a very characteristic aspect.

Obs.—I do not feel at all certain as to the identification of this species with the *Tragos capitatum* of Goldfuss; since no thin sections of the original of the latter are in existence, and the preparation of such might very possibly show that the form which Goldfuss had in view was really the subsequently described *P. Goldfussii* of Bargatzky. Owing to the very close general resemblance between the form

now under consideration and that described by Bargatzky as *P. Goldfussii*, I was formerly disposed to think (General Introduction, p. 104) that we had to deal with a single species only, for which the specific name given by Goldfuss should be retained; but I am now satisfied that the two are really distinct. This being the case, it will be best to retain Bargatzky's name for the species to which he originally gave it, and to apply provisionally to the present species the title given by Goldfuss. I was also formerly disposed to think (loc. cit.) that this species might be referred to the genus *Idiostroma*, Winch.; but a further and more complete investigation has shown that the large and irregular tabulate tubes by which the cœnosteum is traversed are really of the nature of astrorhizal canals, and that the proper place of the species is in the genus *Parallelopora*.

In the general form of the cœnosteum, the characters of the surface, the general structure of the skeletal tissue, the irregular development of the astrorhizæ, and the common presence of scattered lenticular or globular vesicles (ampullæ?) of large size, the present species very closely resembles *P. Goldfussii*, Barg. It is, however, distinguished from the latter by the very much coarser nature of the cœnosteal tissue; so that even with the aid of a pocket lens only it is usually easy to separate examples belonging to these two types. All the specimens of *P. capitata* which I have investigated are more or less highly mineralised; and in most cases the minute structure of the skeleton-fibre has been largely or wholly destroyed. It is, therefore, rarely possible to fully determine the characters of the skeleton-fibre; but so far as these can be made out they agree essentially with those distinctive of *P. Goldfussii*. From *P. dartingtonensis*, Cart. sp., the present form is at once distinguished by its greatly more robust fibre and the irregular development of the astrorhizæ.

Distribution.—*P. capitata*, Goldf. sp., occurs commonly in the Middle Devonian Limestone of Hebborn (Paffrath district), in association with *P. Goldfussii*, Barg.; but it appears to be wholly absent at Steinbreche (Refrath), where the latter species is very abundant. The species also occurs, though by no means plentifully, in the Devonian pebbles in the Triassic breccias of South Devon.

3. PARALLELOPORA DARTINGTONENSIS, *Carter* sp. Pl. IV, fig. 1; Pl. XXIV, figs. 13—15; and Pl. XXV, figs. 1—3.

STROMATOPORA ELEGANS, *Carter*. Ann. and Mag. Nat. Hist., ser. 5, vol. iv, p. 263, 1879 (non *Stromatopora elegans*, Rosen).

— DARTINGTONENSIS, *Carter*. Ibid., vol. vi, p. 346, pl. xviii, figs. 1—5, 1880 (fig. 1 of the plate is doubtfully referable to this species, and perhaps belongs to *Stromatoporella eifeliensis*, Nich.).

The cœnosteum in *P. dartingtonensis*, Cart. sp., is massive or laminar in form, and often attains a considerable size; the mode of attachment and condition of the under surface is not thoroughly known. The mode of growth is often more or less clearly latilaminar, though in many specimens this feature is not conspicuous. The concentric laminæ are generally simply curved or slightly undulated. The astrorhizæ (Plate XXIV, figs. 13 and 14) are extensively but variably developed, consisting usually of large stellate branching canals, the cavities of which are crossed by more or fewer internal partitions ("astrorhizal tabulæ"). Commonly the astrorhizæ are arranged in vertically superimposed systems, each system being connected with an axial wall-less canal; but this disposition of parts is not always recognisable. Owing to the curvature of the concentric laminæ, the astrorhizal canals commonly exhibit a more or less truncated or irregular disposition in straight tangential sections (Plate XXIV, fig. 13), while their cut ends appear at intervals in vertical sections as large rounded or oval apertures. The centres of the astrorhizæ are usually from 1 to 2 cm. apart. The condition of the surface is imperfectly known, but it is probable that there were more or less pronounced eminences or "mamelons," corresponding with the centres of the astrorhizal systems.

As regards the minute structure of the skeleton, an examination of the surface of polished specimens with a pocket lens clearly shows the skeleton-fibre to possess the perforate or cribriform character which distinguishes the species of *Parallelopora*. Owing, however, to the bad state of preservation of most specimens, this feature is often more or less completely lost in thin sections; though indications of it may be observed in most examples, and in a few cases the structure in question can be clearly observed (Plate XXV, fig. 2).

When examined in thin tangential sections (Plate XXIV, fig. 15; and Plate XXV, fig. 2) the cœnosteal tissue is seen to be essentially of the reticulate type, though the reticulation is not so complete as in the species of *Stromatopora* proper. Such sections also commonly show the transversely partitioned astrorhizal canals. Vertical sections (Plate XXV, figs. 1 and 3) show the cœnosteum to be made up of delicate, close-set, and very distinct radial pillars, which are united at short and regular intervals by comparatively thin horizontal cross-bars, these latter giving rise to the appearance of regular and closely arranged "concentric laminæ." About nine or ten pillars occupy a space of 2 mm. measured transversely, and about the same number of "concentric laminæ" occupy this space measured vertically. The spaces between the radial pillars represent the zoöidal tubes, and these, in well-preserved specimens, exhibit a moderate number of straight or curved tabulæ.

Obs.—As regards its larger characters, so far as these are known, *Parallelopora dartingtonensis* is chiefly distinguished from the allied *P. Goldfussii*,

cavities of the cœnosteum, have been filled, as previously explained (p. 31), with a more or less opaque calcareous mud, while the real skeleton has been more or less extensively converted into transparent calcite. A "reversed" state of preservation is, however, by no means peculiar to the present species, and I have noticed it in *Stromatopora florigera*, Nich., *S. inæqualis*, Nich., and occasionally in *S. concentrica*, Goldf.

I have never seen an example of *S. dartingtonensis* in the "Caunopora-state," though there is no reason to doubt that it occurs occasionally in this condition.

Distribution.—*Parallelopora dartingtonensis*, Cart. sp., has hitherto been recognised only in the Middle Devonian Limestones of Devonshire. The ordinary form of the species is not uncommon at Pit-Park Quarry, Dartington (the original locality for the species). Both the normal form of the species and the variety *filitexta* occur not uncommonly in the Devonian pebbles of the Triassic conglomerates of South Devon.

Genus 3.—STROMATOPORELLA, *Nicholson*, 1886.

(General Introduction, p. 92.)

1. STROMATOPORELLA GRANULATA, *Nich.* Pl. I, figs. 4 and 5 and 14 and 15; Pl. IV, fig. 6; Pl. VII, figs. 5 and 6; and Pl. XXVI, fig. 1.

STROMATOPORA GRANULATA, *Nicholson*. Ann. and Mag. Nat. Hist., ser. 4, vol. xii, p. 94, pl. iv, figs. 3, 3 *a*, 1873.
— — — Ibid., ser. 5, vol. xviii, p. 10, 1886.

The cœnosteum in this species forms laminar expansions of considerable size, which are not incrusting, but are attached basally by a peduncle, and have the rest of the lower surface covered by a concentrically wrinkled and striated epitheca. The thickness of the cœnosteum varies from less than 2 mm. up to 2 or 3 cm. The surface (Plate XXVI, fig. 1, and Plate IV, fig. 6) shows a variable number of low rounded or conical eminences or "mamelons," the apices of which are usually perforated, each showing in general a single circular opening representing the axial canal of one of the astrorhizal systems. From the apices of the mamelons radiate more or less conspicuous astrorhizal gutters, and the general surface is covered with close-set tubercles of various sizes, the smaller of these being imperforate, while the larger ones are pierced at their apices by distinct circular apertures (Plate I, fig. 14). In places the surface-tubercles coalesce into

PLATE XX.

Fig. 1.—Vertical section of a specimen of *Labechia conferta*, Lonsd. sp., from the Wenlock Limestone of Dudley, enlarged about 10 times.

Fig. 2.—Tangential section of the same specimen, similarly enlarged.

Fig. 3.—Small portion of the preceding section, enlarged about 30 times.

Fig. 4.—Upper surface of a specimen of *Labechia scabiosa*, Nich., from the Wenlock Limestone of Dudley, of the natural size.

Fig. 5.—Under surface of the same, of the natural size.

Fig. 6.—Surface-tubercles of *Labechia scabiosa*, enlarged.

Fig. 7.—Portion of a polished slab of *Labechia stylophora*, Nich., from the Middle Devonian of Shaldon, Devonshire, of the natural size.

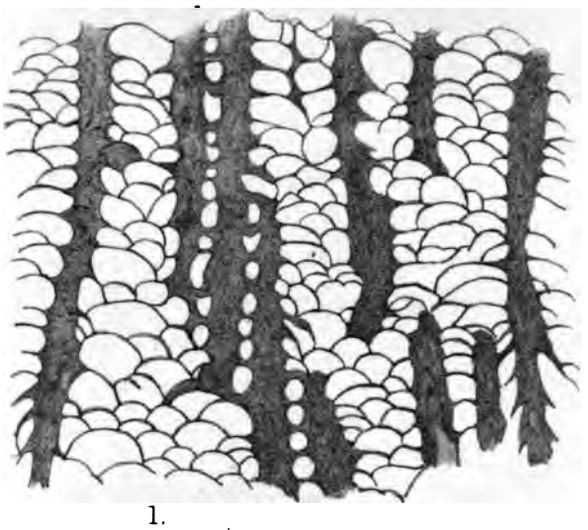
Fig. 8.—A single cylinder of the same transversely divided, enlarged 5 times.

Fig. 9.—Vertical section of *Labechia canadensis*, Nich. and Mur. (?), from the Ordovician Rocks of Aldons, near Girvan, enlarged 10 times. Collected by Mrs. Robert Gray.

Fig. 10.—Polished slab of *Stromatopora concentrica*, Goldf., cut vertically to the surface, of the natural size. From the Middle Devonian, Lummaton, Devonshire.

Fig. 11.—Tangential section of a specimen of *Stromatopora concentrica*, Goldf., from the Middle Devonian of Lummaton, Devonshire, enlarged 10 times.

Fig. 12.—Vertical section of a specimen of *Stromatopora concentrica*, Goldf., from the Middle Devonian of Teignmouth, enlarged 10 times.



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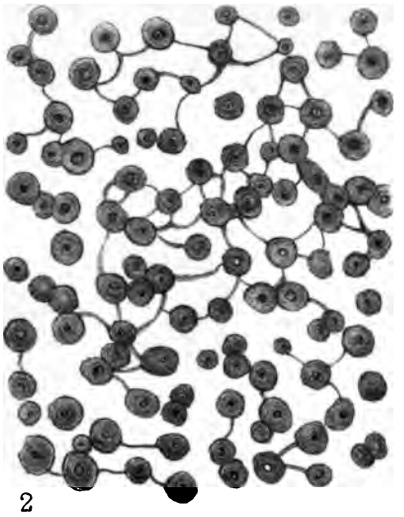

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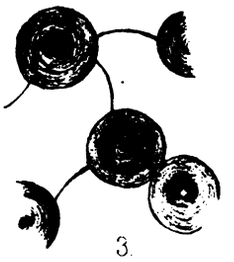

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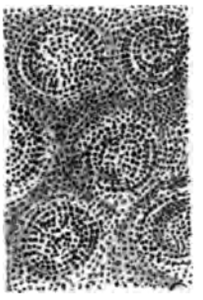

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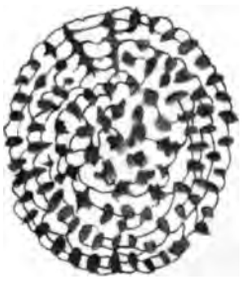

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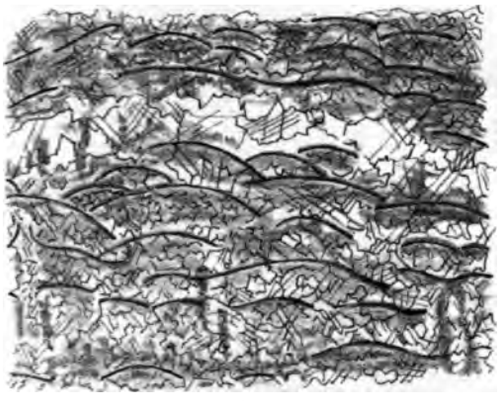

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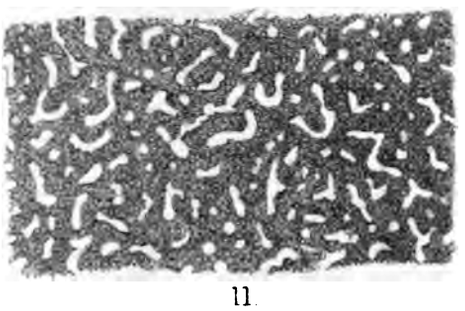

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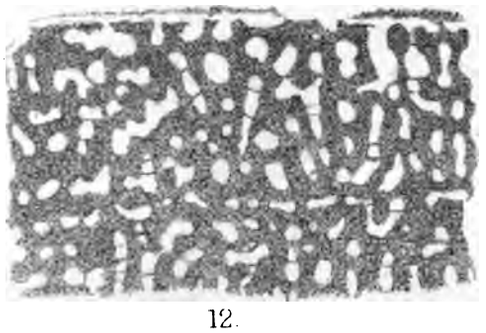

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H. A. Nicholson del.
A. T. Hollick, lith.

PLATE XXI.

Fig. 1.—A massive weathered specimen of *Stromatopora concentrica*, Goldf., from the Middle Devonian of Gerolstein, of the natural size. The specimen shows excellently the growth of the cœnosteum in latilaminæ, and is closely similar in aspect to the original example of this species described and figured by Goldfuss.

Fig. 2.—Portion of the skeleton-fibre of *Stromatopora concentrica*, Goldf., enlarged about 40 times, showing the sieve-like and porous structure of the fibre. The section is tangential, and taken from a specimen from the Middle Devonian of Sötenich, in which the minute structure is unusually well preserved.

Fig. 3.—Portion of the surface of a large specimen of *Stromatopora concentrica*, Goldf., from the Middle Devonian of Gerolstein, enlarged about 3 times. The specimen is traversed by minute "Caunopora-tubes," and the surface-characters are unusually well shown.

Fig. 4.—Upper side of a small specimen of *Stromatopora typica*, Rosen, from the Wenlock Limestone of Ironbridge, of the natural size.

Fig. 5.—Under side of the same, showing the epitheca, of the natural size.

Fig. 6.—Profile view of the same, of the natural size.

Fig. 7.—Part of the surface of the same, enlarged about 3 times.

Fig. 8.—Sketch of a medium-sized specimen of *Stromatopora typica*, Rosen, from the Wenlock Limestone of Dudley, of the natural size. The specimen has been bisected, and shows the latilaminar mode of growth of the cœnosteum.

Fig. 9.—Portion of the skeleton-fibre of another specimen of the same, from the Wenlock Limestone of Ironbridge, enlarged about 40 times. The section is tangential.

Fig. 10.—Portion of a vertical section of the preceding, similarly enlarged.

Fig. 11.—Part of the surface of a specimen of *Stromatopora typica*, Rosen, of the natural size, in which the cœnosteum is traversed by numerous irregular "Caunopora-tubes," which in this case seem to certainly belong to a species of *Aulopora*. The specimen is from the Drift of Northern Germany, and was presented to the author by Prof. Ferdinand Roemer.

PLATE XXI.

H. A. Nicholson del.
A. T. Hollick, lith.

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PLATE XXII.

Fig. 1.—Tangential section of *Stromatopora typica*, Rosen, from the Wenlock Limestone of Ironbridge, enlarged about 10 times.

Fig. 2.—Vertical section of the same, similarly enlarged, showing the tabulate zoöidal tubes.

Fig. 3.—Vertical section of *Stromatopora Hüpschii*, Barg., from the Middle Devonian of Teignmouth, enlarged 10 times.

Fig. 4.—Tangential section of the same, similarly enlarged.

Fig. 5.—Surface of a polished specimen of the same from the same locality, of the natural size.

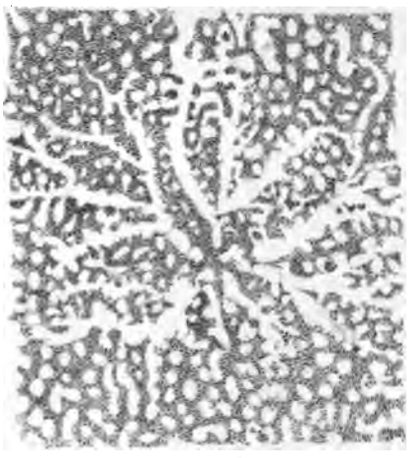
Fig. 6.—Surface of a specimen of *Stromatopora Hüpschii*, Barg., from the Middle Devonian of Büchel (Paffrath district), enlarged 5 times, showing the mouths of "Caunopora-tubes."

Fig. 7.—A weathered example of *Stromatopora Hüpschii*, Barg., in the "Caunopora-state," of the natural size. Middle Devonian, Dartington, South Devon.

Fig. 8.—A small polished example of *Stromatopora florigera*, Nich., of the natural size, from the Middle Devonian of Teignmouth.

Fig. 9.—Tangential section of the same, enlarged 10 times.

Fig. 10.—Vertical section of the same, similarly enlarged.



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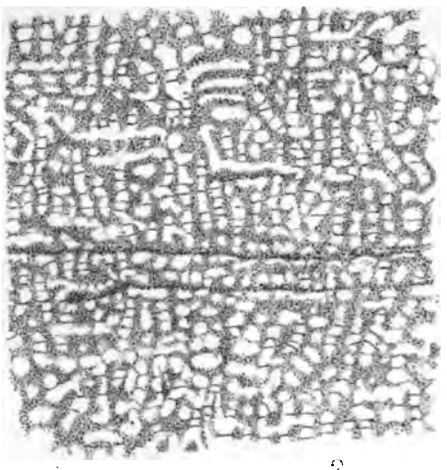

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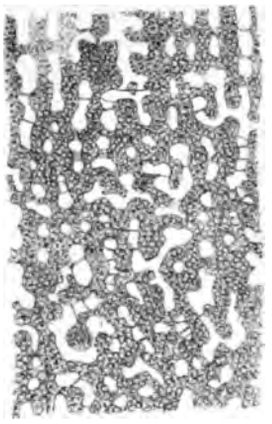

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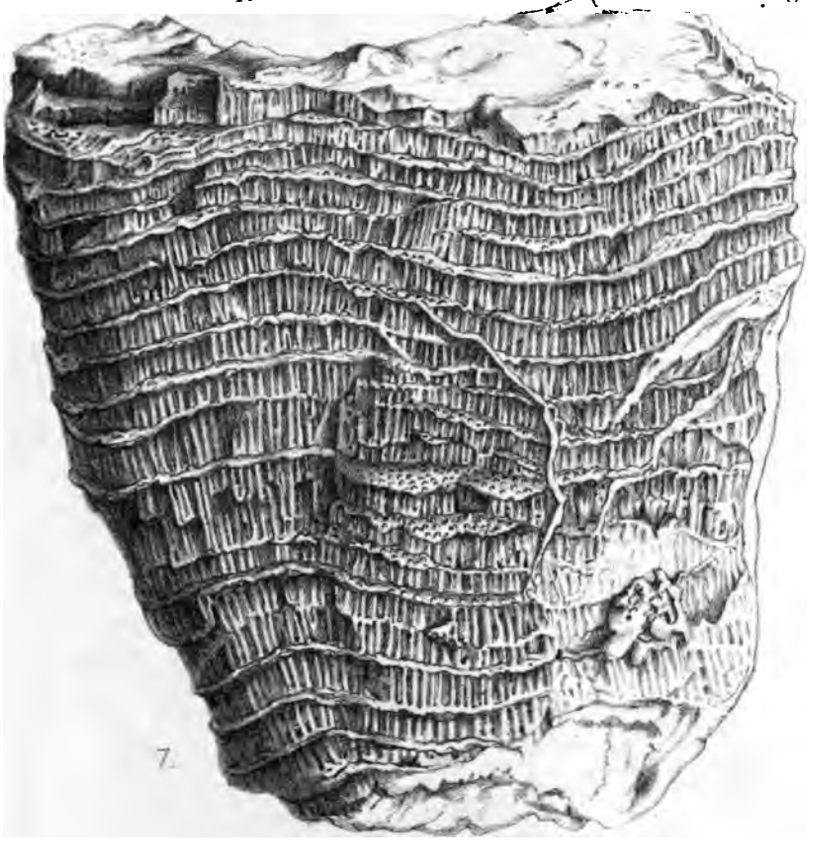

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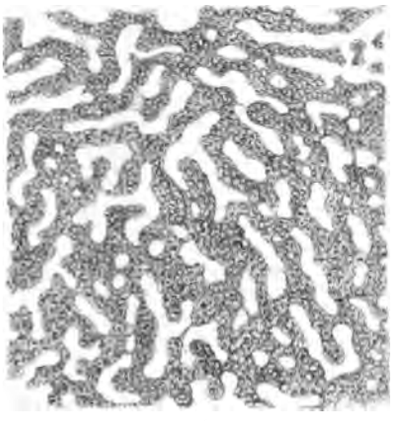

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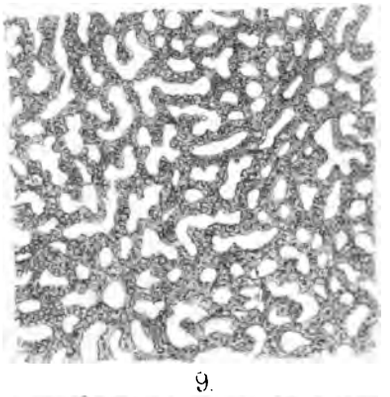

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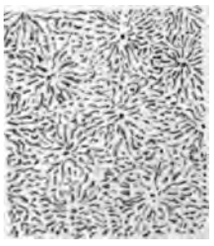

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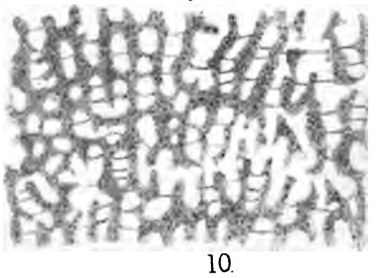

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H. A. Nicholson del.
A. T. Hollick, lith

Lith. Imp. Comb. Oxford

PLATE XXIII.

Fig. 1.—Portion of a polished specimen of *Stromatopora Carteri*, Nich., of the natural size, showing the growth of the cœnosteum in latilaminæ. From the Wenlock Limestone of Ironbridge.

Fig. 2.—Vertical section of the same, enlarged about 10 times.

Fig. 3.—Tangential section of the same, similarly enlarged.

Fig. 4.—A fragment of *Stromatopora Bücheliensis*, Barg., var. *digitata*, Nich., of the natural size. Middle Devonian, Pit Park Quarry, Dartington.

Fig. 5.—Part of a polished transverse section of another specimen of the same species from the same locality, natural size.

Fig. 6.—Vertical section of a specimen of *Stromatopora Bücheliensis*, Barg., from the Middle Devonian of Teignmouth. Enlarged about 10 times.

Fig. 7.—Transverse section of the preceding specimen, similarly enlarged.

Fig. 8.—Portion of a polished specimen of *Stromatopora Beuthii*, Barg., cut tangentially, of the natural size. Middle Devonian, South Devonshire.

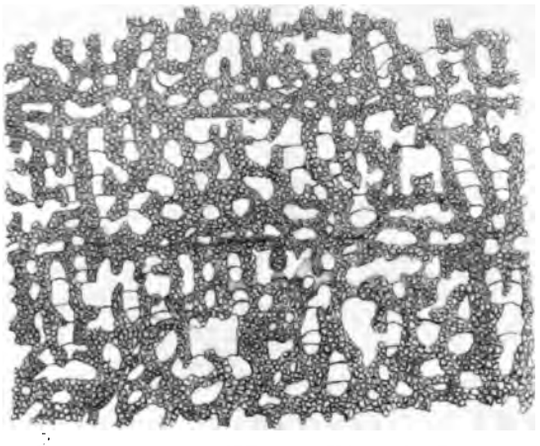
Fig. 9.—Portion of a similar polished specimen of the same species, cut vertically, of the natural size. Middle Devonian, Teignmouth.

Fig. 10.—Tangential section of *Stromatopora Beuthii*, Barg., enlarged about 10 times. Middle Devonian, Pit-Park Quarry, Dartington.

Fig. 11.—Vertical section of the same specimen, similarly enlarged.

Fig. 12.—Tangential section of a specimen of *Stromatopora Beuthii*, Barg., from the Middle Devonian of South Devonshire (Bishopsteignton ?), enlarged about 10 times. The section shows, more distinctly than fig. 10, the cut ends of the radial pillars immersed in the general reticulation.

Fig. 13.—Tangential section of *Stromatopora Beuthii*, Barg. (?), in the "Caunopora-state," enlarged about 10 times. In this condition sections of *S. Beuthii* are hardly, or not at all, distinguishable from similar sections of *S. Hüpschii*, Barg. Middle Devonian, Teignmouth.



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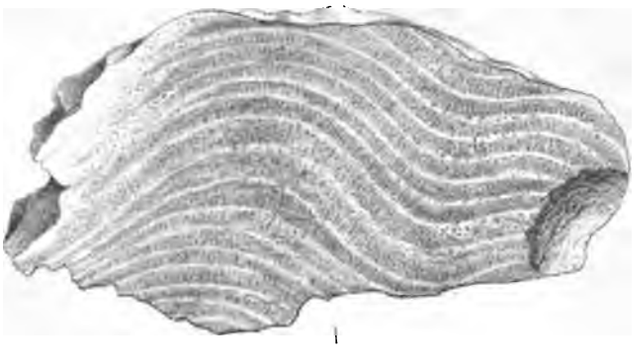

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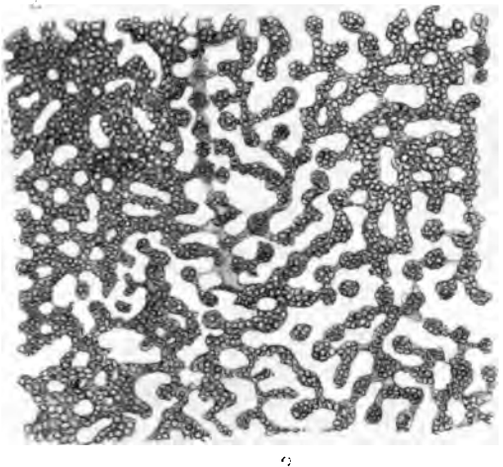

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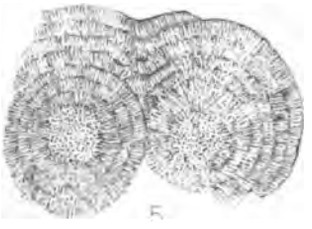

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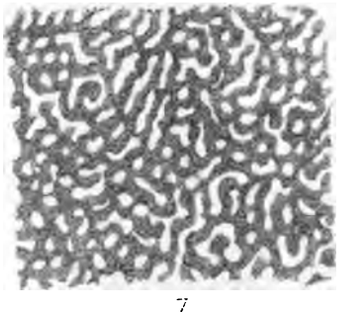

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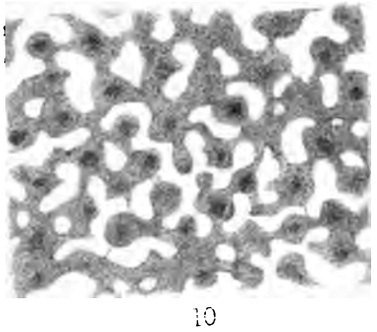

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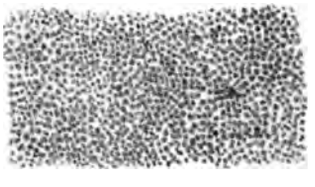

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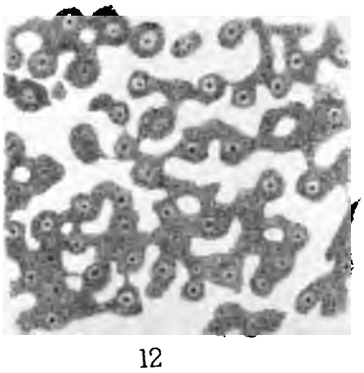

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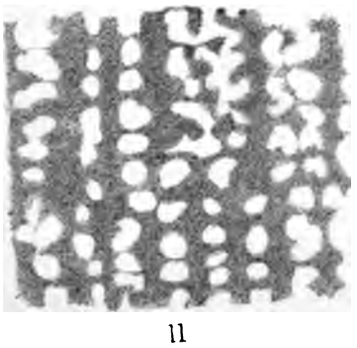

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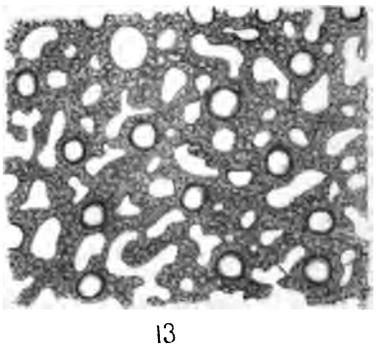

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H. A. Nicholson, del.
A. T. Hickin, lith.

PLATE XXIV.

Fig. 1.—Vertical section of *Stromatopora Beuthii*, Barg. (?), in the "Caunopora-state," enlarged about 10 times. Middle Devonian, Teignmouth.

Fig. 2.—Part of the surface of a specimen of *Stromatopora discoidea*, Lonsd., of the natural size, showing the form and arrangement of the astrorhizæ. Wenlock Limestone, Dudley.

Fig. 3.—Small portion of the surface of a specimen of *Stromatopora discoidea*, Lonsd., enlarged 5 times. Wenlock Limestone, Gotland.

Fig. 4.—Part of the surface of the preceding specimen, still further enlarged.

Fig. 5.—Skeleton-fibre of *Stromatopora discoidea*, enlarged about 40 times.

Fig. 6.—Tangential section of a very well preserved specimen of *Stromatopora discoidea*, Lonsd., enlarged about 10 times. Wenlock Limestone, Ironbridge.

Fig. 7.—Vertical section of the preceding specimen, similarly enlarged.

Fig. 8.—Tangential section of the *Stromatopora elegans* of von Rosen, enlarged ten times. This form is in reality based on an example of *S. discoidea*, Lonsd., in a considerably altered state, and the specific name "*elegans*" must therefore be abandoned. The specimen is from the Silurian Rocks of Kleine Ruhde, in Esthonia.

Fig. 9.—Part of a tangential section of *Stromatopora concentrica*, Goldf., var. *astrigera*, Nich., enlarged 10 times. The specimen is in a much altered and partially "reversed" condition, and the part figured shows the centre of an astrorhiza. Middle Devonian, Teignmouth.

Fig. 10.—Surface of a polished specimen of the preceding, of the natural size, showing the form and arrangement of the astrorhizæ, from the same locality. The astrorhizæ have been drawn for distinctness' sake as if darker in colour than the general skeleton, but they are really lighter.

Fig. 11.—Portion of the surface of a polished specimen of *Stromatopora inæqualis*, Nich., enlarged about twice. Middle Devonian, Teignmouth.

Fig. 12.—Tangential section of the same, enlarged about 5 times, from the same locality. The specimen is in the "reversed" condition.

Fig. 13.—Portion of a polished tangential section of *Parallelopora dartingtonensis*, Carter sp., of the natural size, showing the astrorhizæ. Middle Devonian, Teignmouth.

Fig. 14.—Portion of a polished tangential section of a "reversed" specimen of the same, enlarged twice. Middle Devonian, Teignmouth. The minute structure of this specimen, as displayed in thin tangential section, is shown in Plate IV, fig. 1.

Fig. 15.—Tangential section of a specimen of *P. dartingtonensis*, Cart. sp., from the Middle Devonian of Pit-Park Quarry, Dartington, enlarged 10 times.

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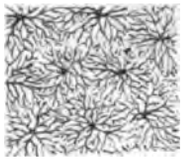

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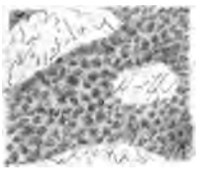

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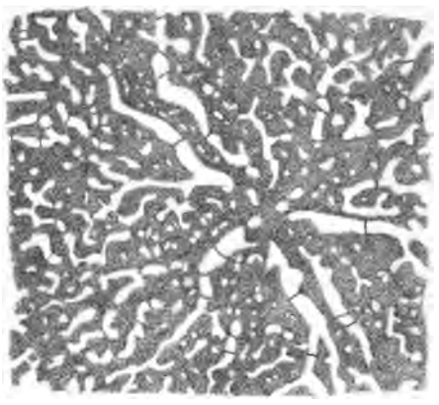

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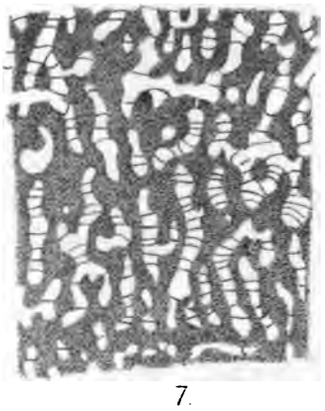

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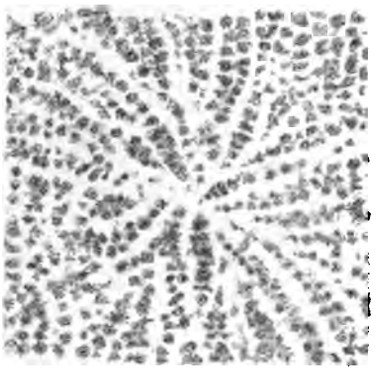

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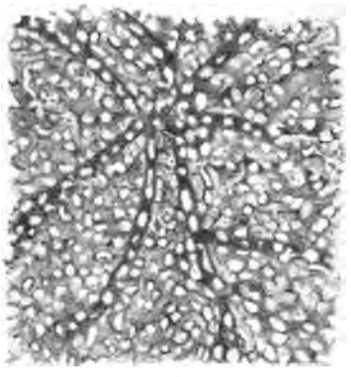

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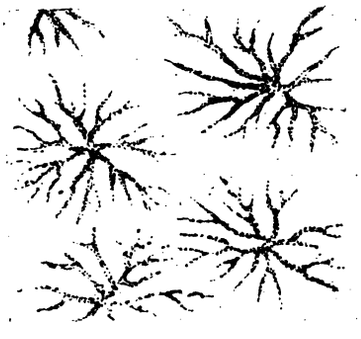

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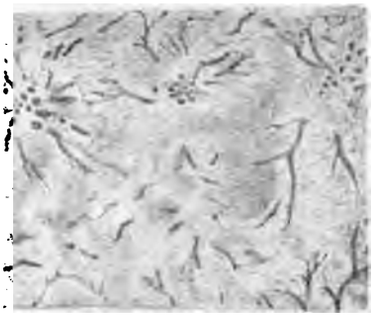

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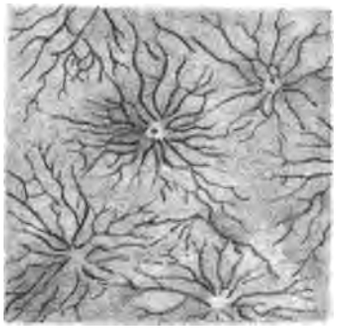

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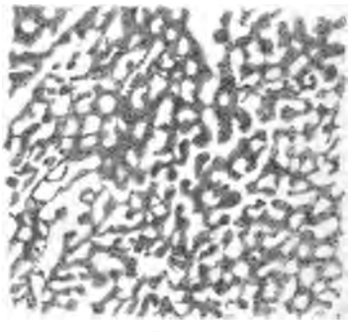

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A. T. Hollick, lith.

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PLATE XXV.

Fig. 1.—Vertical section of the preceding specimen of *Parallelopora dartingtonensis*, Cart. sp., enlarged 10 times.

Fig. 2.—Tangential section of *P. dartingtonensis*, var. *filitexta*, Nich., from the Middle Devonian of Teignmouth, enlarged 10 times.

Fig. 3.—Vertical section of the preceding specimen, similarly enlarged.

Fig. 4.—Tangential section of a typical example of *Parallelopora Goldfussii*, Barg., enlarged 10 times, showing the perforate structure of the skeleton-fibre, the apertures of the zoöidal tubes, and the transversely partitioned astrorhizal canals. Middle Devonian, Steinbreche, Refrath.

Fig. 5.—Vertical section of the same, similarly enlarged, showing the characters of the skeleton-fibre, the radial pillars, and the tabulate zoöidal tubes.

Fig. 6.—Tangential section of the skeleton-fibre of a specimen of *P. Goldfussii*, Barg., from the Middle Devonian of Devonshire, enlarged 40 times.

Fig. 7.—Vertical section of the same, similarly enlarged. (Figs. 7 and 8 of Plate XI, erroneously referred to *Idiostroma ? capitatum*, Goldf., really belong to this species.)

Fig. 8.—Tangential section of the preceding specimen of *P. Goldfussii*, Barg., from the Middle Devonian of Devonshire, enlarged 10 times. The specimen is in the "Caunopora-state."

Fig. 9.—Vertical section of the same, similarly enlarged. The section shows the infundibuliform tabulæ of the "Caunopora-tubes."

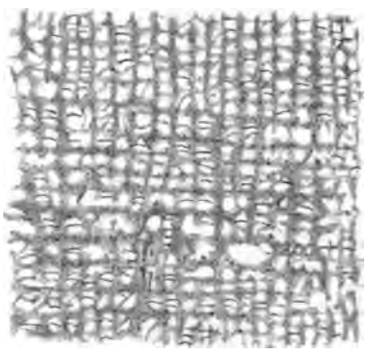
Fig. 10.—Tangential section of a specimen of *Parallelopora capitata*, Goldf. sp., from the Middle Devonian of Teignmouth, showing the tabulate astrorhizal tubes, enlarged 10 times.

Fig. 11.—Tangential section of another specimen of the same from the same locality and formation, similarly enlarged.

Fig. 12.—Vertical section of the preceding specimen of *Parallelopora capitata*, Goldf. sp., showing tabulate zoöidal tubes and supposed "ampullæ," enlarged 10 times.

Fig. 13.—Tangential section of a specimen of *Parallelopora capitata*, Goldf. sp., from the Middle Devonian of Hebborn, showing the structure of the skeleton-fibre, enlarged 10 times.

PLATE XXV.



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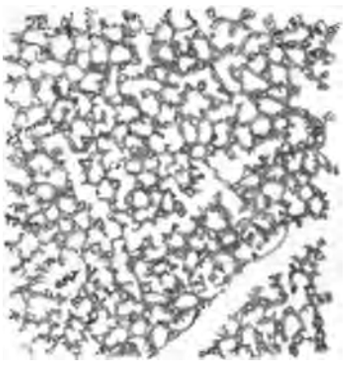

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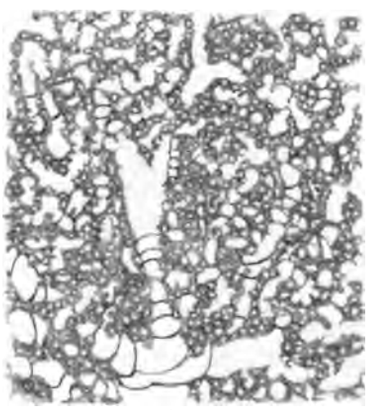

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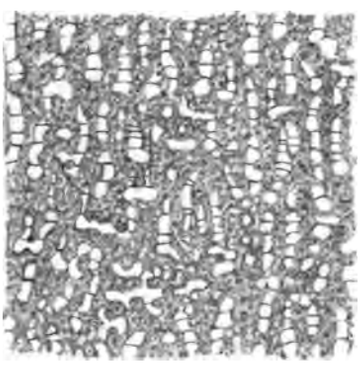

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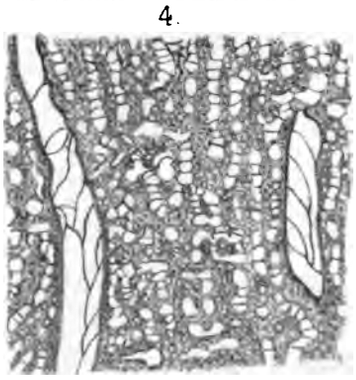

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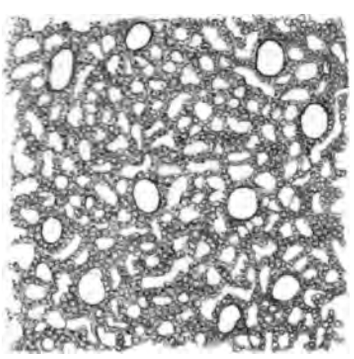

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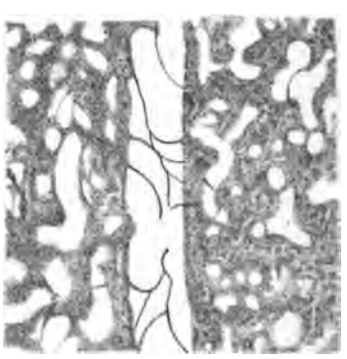

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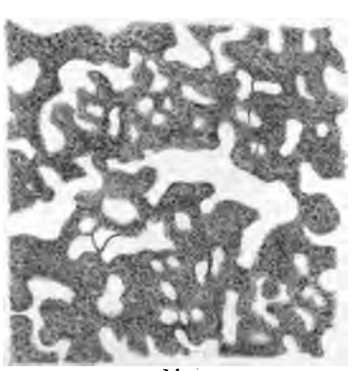

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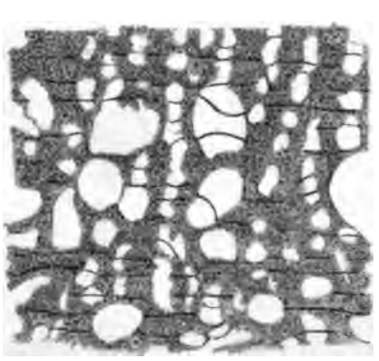

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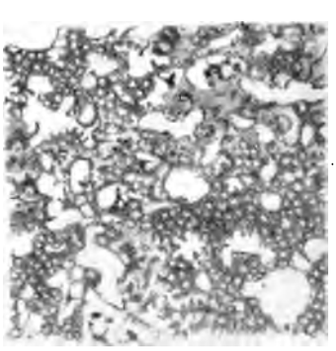

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THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

VOLUME FOR 1890.

LONDON:
MDCCCXCI.

A MONOGRAPH

ON THE

BRITISH FOSSIL

ECHINODERMATA

FROM

THE CRETACEOUS FORMATIONS.

VOLUME SECOND.

THE ASTEROIDEA.

BY

W. PERCY SLADEN, F.L.S., F.G.S., &c.,
SECRETARY OF THE LINNEAN SOCIETY.

PART FIRST.

PAGES 1—28 ; PLATES I—VIII.

LONDON:
PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.
1891.

PRINTED BY
ADLARD AND SON, BARTHOLOMEW CLOSE.

A MONOGRAPH

ON THE

FOSSIL ECHINODERMATA

OF THE

CRETACEOUS FORMATIONS.

THE ASTEROIDEA.

INTRODUCTORY REMARKS.

It was the intention of the late Dr. Thomas Wright to have continued his magnificent series of Monographs on the British Fossil Echinodermata of the Oolitic and Cretaceous Formations, which have already appeared in the volumes of the Palæontographical Society, by the publication of a Monograph on the Cretaceous Asteroidea. With this object in view a number of plates had been prepared under Dr. Wright's directions, and some preparatory notes for the letterpress had been written, when the work was cut short by the lamented death of the author. Subsequently the Council of the Palæontographical Society did me the honour of inviting me to undertake the memoir. The plates and notes above mentioned were placed at my disposal, but the latter proved to be for the main part merely summaries or transcripts of descriptions already published, and were unfortunately unsuitable to form part of the letterpress. For the whole of the latter I am

therefore responsible. The plates which were drawn on stone have all been utilised, although the specimens illustrated were not in every case those which I should have selected, nor the order in which the figures are associated on some of the plates that which I should have followed. This, however, is a comparatively small matter, and the remark is not intended in any way as disparaging the excellence of the illustrations. Indeed, I would here bear unqualified testimony to the careful and accurate way in which the fossils have been delineated by Mr. A. H. Searle. His plates are monuments of patient study of morphological detail, and of exquisite technical execution as examples of lithographic drawing.

In his Monograph on the Oolitic Asteroidea, Dr. Wright gave as an introduction a general account of the structure of the main divisions of the Asteroidea then known, recent as well as fossil, with special reference to the calcareous framework; and he also gave a summary of the different systems of classification which had been formulated by previous writers on the subject. It would therefore, in my opinion, be out of place, and in a certain measure superfluous, to preface the present memoir with a similar introduction; but, as the knowledge of recent Starfishes has been considerably extended since the date of Dr. Wright's contribution, I propose to give in an appendix to this monograph my views on the classification of the Asteroidea, with special reference to the fossil forms.

At the commencement of his splendid Monograph on the Cretaceous Echinoidea—to which the present memoir is a sequel—Dr. Wright gave a valuable stratigraphical summary of the Cretaceous Formations in Britain. It is consequently altogether needless to burden the pages of the Society's publications with a repetition of these details. I shall, however, if necessary on the completion of my work, give a synopsis of the distribution in time of the various species dealt with, together with such remarks on their occurrence and associations as occasion may require.

FOSSIL ASTEROIDEA.

DESCRIPTION OF THE CRETACEOUS SPECIES.

Sub-class—EUASTEROIDEA, *Sladen*, 1886.

Order—PHANEROZONIA, *Sladen*, 1886.

Family—PENTAGONASTERIDÆ, *Perrier*, 1884.

Phanerozonate Asterids, with thick and massive marginal plates, which may be either naked, or bear granules or spiniform papillæ. Disk largely developed. Apical plates often increscent. Abactinal surface tessellate, with rounded, polygonal or stellate plates, which may be tabulate or paxilliform. Actinal interradial areas largely developed, covered with pavement-like plates, which may be naked or covered with membrane, or may bear granules or spinelets.

The family Pentagonasteridæ, as defined by Prof. Edmond Perrier[1] in 1884, was separated from a larger and more comprehensive group of genera which had been previously recognised by him[2] as constituting the family Goniasteridæ. The name Goniasteridæ was not retained for any of the groups or families into which that incongruous series of genera was divided. Previous to 1875, even the generic name of *Goniaster* had been very loosely and incorrectly applied. The vaguest notions as to the limits or characters of the genus seem to have been held. The mere form of the body, and the applicability of the significant name, irrespective of structural details, appear to have alone determined the reference of a large number of the species which have at different times borne the generic name of *Goniaster*.

[1] 'Nouv. Archives Mus. Hist. Nat.,' 2e série, 1884, t. vi, p. 165.

[2] 'Révis. Stell. Mus.,' p. 25 ('Archives de Zool. expér.,' 1875, t. iv, p. 289).

M. Perrier showed that none of the recent species ranked as *Goniaster* previous to 1875 had any right to be so called. He consequently employed the name in a new and restricted sense, taking the *Asterias obtusangula* of Lamarck as the type of the genus. No other species is at present known which can be regarded as congeneric with that form.

A large number of fossil Starfishes have been named as species of *Goniaster*, but none of them present characters which justify their reference to that genus in its new sense, and none of them invalidate the course taken by Prof. Perrier. It will therefore be unnecessary in the following pages to discuss in each case separately the reasons for removing the large number of species which have from time to time been ranked under the name of *Goniaster*.

Subfamily—PENTAGONASTERINÆ, *Sladen*.

PENTAGONASTERINÆ, *Sladen*. Zool. Chall. Exped., part li, Report on the Asteroidea, 1889, pp. xxxi, 262.

Pentagonasteridæ with the abactinal area paved with rounded, polygonal, or paxilliform plates. Granules or spinelets when present co-ordinated.

Genus—CALLIDERMA, *Gray*, 1847.

CALLIDERMA, *Gray*. Proc. Zool. Soc. Lond., part xv, 1847, p. 76; Ann. and Mag. Nat. Hist., 1847, vol. xx, p. 198; Synop. Spec. Starf. Brit. Mus., 1866, p. 7.

Marginal contour stellato-pentagonal. General form depressed. Disk large and flat. Rays moderately elongated and tapering. Marginal plates forming a broad border to the disk, and may be united along the median abactinal line of the ray throughout [or, in some fossil species, may be separated by one or more series of medio-radial plates, at least at the base of the ray]. The marginal plates of both series are granulated. [In recent species the supero-marginal plates bear some small papilliform spinelets on the margin where the abactinal and lateral surfaces of the plate unite; and the infero-marginal plates have a number of similar, but larger and more fully developed, spinelets irregularly distributed amongst the granulation of the actinal surface.] Abactinal area of the disk covered with small and regularly arranged plates, hexagonal in the radial areas, bearing co-ordinated granules, and some with a larger, globular, central,

Another point of difference is to be found in some of the fossil forms which are referred in the following pages to the genus *Calliderma*; and this consists in the separation of the supero-marginal plates, at least at the base of the ray, by one or more series of medio-radial plates. It is a character whose importance is not to be under-estimated, but too little as yet is known of the morphological plasticity of the genus to justify in my opinion the separation of the forms on this ground alone. I prefer, therefore, to regard this extension of the abactinal plating as a transitional character, and I believe that this opinion is warranted by the range of plasticity observed in other genera of recent Asteroidea.

1. CALLIDERMA SMITHIÆ, *Forbes*, sp. Pl. I, figs. 1 *a*—1 *f*; Pl. VIII, figs, 2 *a*—2 *c*.

GONIASTER (ASTROGONIUM) SMITHII, *Forbes*, 1848. Memoirs of the Geological Survey of Great Britain, vol. ii, p. 474.

— — — — 1850. In Dixon's Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex, London, 4to., p. 384, pl. xxii, figs. 1 and 2.

— — SMITHIÆ, *Morris*, 1854. Catalogue of British Fossils, 2nd ed., p. 80.

ASTROGONIUM SMITHII, *Dujardin and Hupé*, 1862. Hist. Nat. Zooph. Échin. (Suites à Buffon), p. 399.

GONIASTER SMITHI, *Quenstedt*, 1876. Petrefactenkunde Deutschlands, I. Abthl., Bd. iv, p. 64.

— (ASTROGONIUM) SMITHIÆ, *Forbes*, 1878. In Dixon's Geology of Sussex (new edition, Jones), p. 367, pl. xxv, figs. 1, 2, 2 *a*.

Body of large size. General form depressed. Abactinal area probably capable of slight inflation, and more or less flexible: a slight carination being present in the radial abactinal regions. Actinal surface flat. Marginal contour stellato-pentagonal, the major radius measuring rather more than twice the minor radius. Rays broad at the base and tapering gradually to the extremity. Interbrachial arcs well rounded and forming a regular curve. Margin thick, with a well-defined channel traversing the line of junction of the supero-marginal and infero-marginal series of plates, formed by the tumid character of the marginal surface of both series of plates.

The infero-marginal plates are about twenty or twenty-one in number, counting

from the median interradial line to the extremity. They form a broad conspicuous border to the actinal area, the breadth of which diminishes gradually from the median interradial line to the extremity. The largest infero-marginal plates near the median interradial line measure 9 mm. in breadth, and 4 mm. in length; the length increases a little between this point and the base of the ray, where it is again 4 mm. The breadth decreases step by step from the median interradial line, and at the base of the ray is less than 4 mm., and further out the breadth of the plates is less than the length. The height of the infero-marginal plates as seen in the margin is greater than the length of the plate, the proportions near the median interradial line being as 3 : 2 approximately. The proportion of the height decreases at the extremity of the ray. The infero-marginal plates are slightly convex on their actinal surface and distinctly tumid on their marginal surface. The whole superficies is covered with small, hexagonal, closely-placed punctations, upon which granules were previously borne, probably uniform in size and compactly placed. On a number of the plates are one or more subcircular or irregular shallow concavities, quite irregular in size, position, and occurrence, which I believe to have been caused by the presence of a pedicellarian apparatus, perhaps the cavities of ordinary foraminate pedicellariæ enlarged by weathering. These are seen in Pl. I, figs. 1 *a*, 1 *b*, 1 *c*, 1 *d*. I scarcely think that they are the marks left by tubercles or enlarged granules. In the example, however, figured on Pl. VIII, fig. 2 *a*, small spinelets were undoubtedly present.

The adambulacral plates are broader than long, their dimensions at a short distance from the mouth being 3·25 mm. broad and 1·75 mm. long. They bear upon their surface four or five ridges, parallel or sub-parallel to the ambulacral furrow, each with five or six articulatory elevations upon which spines had previously been borne. A number of these spines are still preserved, irregularly strewed over the surface of the plates. They are short, tolerably robust, slightly flattened, slightly tapering and abruptly rounded at the tip. The longest measures about 1·5 mm. in length, or a little more; their surface is finely striate, in fact so fine that the character is perhaps mainly due to the effect of weathering upon the structural texture of the spine.

The actinal interradial areas are large and are covered with a great number of small, regular, quadrangular or rhomboid intermediate plates, which are arranged in series parallel to the ambulacral furrow, and form a compact tessellated pavement. The average size of the plates is about 2 mm. in diameter, but the plates of the series adjacent to the adambulacral plates are somewhat broader, and the plates near to the infero-marginal plates become smaller and irregular. The plates extend at the base of the ray to about the eighth infero-marginal plate, counting from the median interradial line. The surface of the plates is covered with large, rather widely spaced, hexagonal punctations—the marking left by the granules

previously borne upon the plates, which appear to have been rather large and uniform.

Very few, if any, pedicellariæ appear to have been borne on the actinal intermediate plates.

The character of the mouth-plates and their armature cannot be made out in any of the examples I have examined.

The supero-marginal plates are only exposed in the marginal view of the example under description. Their height is seen to be less than that of the infero-marginal plates, and they are also rather smaller both in length and breadth; about twenty-two appear to be present between the median interradial line and the extremity of the ray. In their general character and ornamentation they resemble closely those of the infero-marginal series.

From another example, also contained in the British-Museum Collection, and bearing the registration mark "E. 2037," in which the abactinal surface is shown, the following details are supplemented.

The abactinal area is covered with small, regular, hexagonal plates or paxillar tabula, which are slightly rounded superficially, and a little bevelled on the margin of the tabulum. The surface of the tabulum is covered with punctations or marks left by the granules originally borne on the plate, and here and there small pedicellarian foramina may be seen, usually near the margin of the plate. The plates (or paxillæ) of the median radial series are broader than any of the others, the largest measuring about 2 mm. in breadth, and a little more than 1 mm. in length. The other tabula are true hexagons, measuring about 1 mm. in diameter or a trifle more, and they are arranged in longitudinal series parallel to the median radial series. Eight or nine series are present on each side of the median radial series on the disk. Opposite the eighth supero-marginal plate, counting from the median interradial line, only the median radial series and one lateral series of tabula on each side of it are present. The median radial series then extends alone and is present at the fourteenth plate, where the ray is broken in the example under description—and looks like continuing further—probably reaching to the extremity of the ray.

Dimensions.—In the type specimen (figured on Pl. I) the major radius is 98 mm., the minor radius 48 mm., the thickness of the margin from 9 to 10 mm. The breadth of a ray between the fifth and sixth infero-marginal plates measures about 28 mm.

Locality and Stratigraphical Position.—The specimen figured on Pl. I is from the Lower or Grey Chalk at Burham, in Kent. The species has also been obtained from the Upper Chalk at Brighton (Coll. Brit. Mus.); and it is sometimes

The supero-marginal plates are about twenty-eight in number, counting from the median interradial line to the extremity. (This number is taken from the fragment figured on Pl. VII, fig. 4 *a*; in the larger example drawn on Pl. V, fig. 2 *a*, twenty-two may be counted up to the place where the ray is broken.) They form a well-defined, conspicuous border, but the breadth of this is distinctly less in proportion to the size of the disk when compared with the breadth of the marginal plates in *Calliderma Smithiæ*. The largest supero-marginal plates in the specimen figured on Pl. V, fig. 2 *a*, near the median interradial line, measure 5·25 mm. in breadth and 3·25 mm. in length. The breadth diminishes very slightly as the plates approach the base of the ray, but from that part outward the length of the plates becomes much reduced—the breadth remaining the greater dimension throughout the ray.

The supero-marginal plates are comparatively flat on the abactinal surface and only slightly depressed along their margins of juncture. The general surface of the whole series has the character of sloping at a small angle to the margin of the disk, to which it gives a slightly bevelled appearance. The marginal surface of the plate is almost vertical, the junction of the abactinal and marginal surfaces is well rounded but not tumid, and there is very slight, if any, convexity on the marginal surface, at least along the disk. The height of the plates as seen in the margin is only a little greater than the length, and the diminution in height is only very trifling as the plates proceed along the ray. The whole superficies of the plates is covered with small hexagonal punctations upon which granules were previously borne. Small foraminate pedicellariæ are occasionally present here and there upon the plates; the foramen is small and oval, and is surrounded by a definite margin or lip. Sometimes more than one are present on one plate. The example figured on Pl. VII, fig. 4 *a*, is remarkable for the presence of the prominent teat-like eminences, in the centre of which the pedicellarian foramen is situated. These eminences at first sight look like tubercles for the articulation of spines (see Pl. VII, figs. 4 *a*, 4 *c*). A similar character is also seen in the example drawn on Pl. V, fig. 2 *a*, but is less strongly marked (see fig. 2 *d*).

The abactinal area of the disk is covered with small, regular, hexagonal and tetragonal plates or paxillar tabula; those in the radial areas being regularly hexagonal and larger than those in the intermediate regions, which are rhomboid, and all diminish in size as they approach the margin. The abactinal plates or paxillæ do not appear to extend beyond the twelfth supero-marginal plate, counting from the median interradial line; the supero-marginal plates of the two sides of the ray meeting in the median radial line beyond this point. The plates or paxillæ of the median radial series are larger and broader than any of the others; they are succeeded on each side by five or six longitudinal series of hexagonal plates, those of the second or third series from the median series measuring about 1·5 mm.

in diameter. The remaining plates which occupy the intermediate areas are tetragonal or rhomboid. All the plates have their surface marked with rather widely-spaced punctations—the impressions of the granules previously present. Small foraminate pedicellariæ are also frequently present here and there, usually near the margin of the plate.

The madreporiform body is flat, distinct, and polygonal in outline; it is situated near the centre of the disk. Its surface is marked by fine straight striæ, which radiate regularly centrifugally from the centre to the margin (see Pl. V, fig. 2 *e*).

Other specimens show that the infero-marginal plates in this species are more nearly subequal to the supero-marginal series than in *Calliderma Smithiæ*, that the actinal intermediate plates are relatively larger than in that species and a good deal larger than the abactinal paxillar plates or tabula. The actinal intermediate plates originally bore granules only, judging from the character of the punctations with which their surface is ornamented. A fragment belonging to the British Museum Collection (which bears the register number "E 373"), in which the spines that formed the armature of the adambulacral plates are preserved, indicates that these spines are smaller, shorter, and perhaps more numerous than in *Calliderma Smithiæ*.

In the example drawn on Pl. VI, fig. 2 *a*, the supero-marginal plates are preserved, but the whole of the abactinal plating has been removed, leaving exposed the inner surface of some of the actinal intermediate plates and the adambulacral plates. Magnified details of these plates are given, and they represent the characters of the structures preserved better than any verbal description.

Dimensions.—The large example figured on Pl. V, fig. 2 *a*, has the following measurements:—Major radius 82 + mm. (all the rays are broken and imperfect, and the full dimensions cannot therefore be given); minor radius 36 mm.; thickness of the margin about 8 mm. Breadth of a ray between the eighth and ninth supero-marginal plates about 15 mm., or a trifle more.

Locality and Stratigraphical Position.—The example figured on Pl. V, fig. 2 *a*, is labelled from the Lower Chalk, but the locality is not recorded. It formed part of one of the old collections preserved in the British Museum. Other examples in the British Museum are from the Grey Chalk or Chalk Marl of Dover, from the Lower Chalk of Glynde in Sussex, and from the Lower Chalk of Amberley Pit, Arundel. There is also a magnificent specimen in the Museum of Practical Geology, Jermyn Street, from the Lower Chalk of Dover.

3. CALLIDERMA LATUM, *Forbes*, sp. Pl. II, figs. 1 *a*—1 *e*, 2 *a*—2 *d*; Pl. III, figs. 1 *a*—1 *e*, 2 *a*, 2 *b*, 3 *a*, 3 *b*.

GONIASTER (ASTROGONIUM) LATUS, *Forbes*, 1848. Memoirs of the Geological Survey of Great Britain, vol. ii, p. 474.

— — — — 1850. In Dixon's Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex, London, 4to., p. 388, pl. xxiii, figs. 4, 5.

— — — *Morris*, 1854. Catalogue of British Fossils, 2nd ed., p. 80.

ASTROGONIUM LATUM, *Dujardin and Hupé*, 1862. Hist. Nat. Zooph. Échin. (Suites à Buffon), p. 399.

GONIASTER (ASTROGONIUM) LATUS, *Forbes*, 1878. In Dixon's Geology of Sussex (new edition, Jones), p. 367, pl. xxvi, figs. 4, 5.

Body of large or moderate size. General form depressed. Abactinal surface probably capable of some degree of inflation. Actinal surface flat. Marginal contour stellato-pentagonal, the major radius probably not exceeding the minor radius by more than one half. Rays narrow at the base, short, not greatly produced, and probably tapered to a pointed extremity. Interbrachial arcs very wide and flattened, which gives a strongly marked pentagonal outline to the disk. Margin of uniform thickness.

The infero-marginal plates are more than sixteen in number, counting from the median interradial line to the extremity (the tip of the ray being broken in all the specimens examined). They form a remarkably broad margin to the actinal area of the disk, which diminishes rather rapidly in width at the base of the rays, and then slightly to the extremity. The largest infero-marginal plates near the median interradial line measure about 13 mm. in breadth and 4·5 mm. in length. The length is nearly uniform throughout, or at any rate till well out on the free part of the ray; but the breadth diminishes until the plates at the base of the ray are 6·5 mm., and the diminution proceeds to a certain extent along the ray. The infero-marginal plates are slightly convex along their line of breadth, by which means the separate plates are distinctly marked. They are well rounded at the junction of the actinal and lateral surfaces, and are slightly tumid in the margin. The outline of their inner or adcentral edge is also rounded. The height of the

infero-marginal plates as seen in the margin is a little greater than their length. The height of the supero-marginal plates is, however, somewhat greater.

The whole superficies of the plates is covered with circular punctations of irregular size rather than hexagons, as in the other forms, and the irregularity caused by the presence of larger punctations here and there is remarkable. This character seems to indicate the former presence of an irregular-sized granulation.

The supero-marginal plates are similar in character to the infero-marginal series, but the large irregular punctations are larger and more numerous.

The adambulacral plates are broader than long, and they bear upon their surface five or six ridges parallel or subparallel to the ambulacral furrow, each with prominent well-defined granulations or elevations, all uniform and closely placed, upon which the adambulacral armature of spines was previously borne (see Pl. II, fig. 1 *d*; Pl. III, fig. 2 *b*).

The actinal interradial areas are large, and are covered with comparatively large polygonal and rhomboid intermediate plates, which are arranged in series parallel to the ambulacral furrow, and originally formed a compact tessellated pavement. In a number of the fossils of this species, however, these plates are often separated and displaced, which leads to the inference that in life the plates were not so intimately connected as in other species, and that membrane or connective tissue was more largely developed. The one or more series of plates adjacent to the adambulacral plates are much larger than the others, and none of the intermediate plates extend beyond the base of the ray. The surface of the plates is covered with large, irregular, and rather deeply sunken pits, the character of which leads to the inference that the granulation originally present was also somewhat irregular in size and coarse in character (see Pl. II, fig. 1 *c*; Pl. III, fig. 1 *e*).

In some examples (notably in that figured on Pl. III, fig. 2 *a*) small oval foraminate pedicellariæ, distinctly lipped at the margin of the foramen, are present on the actinal intermediate plates.

The mouth-plates are elongate, about three times as long as broad, triangular in shape, with the two outer sides subequal. Their surface is covered with large, coarse, irregular, tuberculose elevations (see Pl. II, fig. 1 *e*), which suggest the inference that the armature of the mouth-plates consisted of large, irregular, papilliform granules.

In some examples a portion of the actinal floor has been removed, exposing the inner surface of the abactinal floor. In these cases the stellate base of the abactinal plates or paxillæ are seen (see Pl. II, figs. 2 *a*, 2 *d*; Pl. III, figs. 3 *a*, 3 *b*). It will be noticed that there is a difference in the form of the stellate bases in these examples, which may indicate a specific or varietal difference, but I do not feel justified from this character alone in recognising either of these fragments as the

type of a distinct species. More material is needed before such a step would be warranted.

Dimensions.—The large example figured on Pl. II, fig. 1 *a*, has a major radial measurement of from 80 to 95 mm. or more, with a minor radius of about 52 mm. The breadth of the ray between the sixth and seventh infero-marginal plates, counting from the median interradial line, is about 17 or 18 mm.

Locality and Stratigraphical Position.—This species appears to be confined to the Lower Chalk. Examples have been collected from Washington, Amberley, Southerham, and Glynde, in Sussex. Also from the Lower Chalk of Folkestone, and the Chalk Marl of Dover.

History.—Two examples of this species were first figured by Forbes in Dixon's 'Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex,' London, 1850, pl. xxiii, figs. 4 and 5. Both these specimens are now preserved in the British Museum. One example, which is from Amberley, is drawn on Pl. III, fig. 1 *a*. The other, which is from Washington, is accurately represented by fig. 3 *a* of the same plate.

Variations.—In addition to the difference noted above in the form of the stellate bases of the abactinal plates or paxillæ, other minor differences may be observed. In some examples the breadth of the border formed by the marginal plates on the disk area is not relatively so great as in other examples, and the proportions of length to breadth, as well as the amount of tumidity of the component plates, are subject to variation. In some examples, again, the irregularity in the granulation of the marginal plates, arising from the former presence of coarser granules interspersed amongst the average granulation, is more marked than in others. These differences will be more readily noticed by turning to the figures given on Pl. II and Pl. III than by a lengthy verbal description. Some of the examples come from different beds and different localities—circumstances which I consider to be sufficient to account for the variation.

Genus—NYMPHASTER, *Sladen*, 1885.

NYMPHASTER, *Sladen*. In Narr. Chall. Exp., 1885, vol. i, p. 612; Zool. Chall. Exped., part li, Report on the Asteroidea, 1889, p. 294.

Disk large and flat. Rays elongate, slender, tapering, and almost square in section. Marginal plates forming a broad border to the disk, and either united

along the median abactinal line of the ray throughout, or separated only by a single series of medio-radial plates. The marginal plates of both series are granulated, and bear no spines (normally, but occasional incipient spinelets may be present). Abactinal area of the disk covered with large and regularly arranged plates, those in the radial areas well separated, usually hexagonal, more or less tabulate and paxilliform, and frequently bearing an excavate or entrenched pedicellaria. Actinal interradial areas large, confined to the disk. Actinal intermediate plates well defined, covered with uniform granules, and occasionally bearing pedicellariæ. Armature of the adambulacral plates arranged in longitudinal series. Madreporiform body exposed and situated within one third of the distance from the centre to the margin. Large entrenched pedicellariæ are frequently present on the marginal plates in some species.

This genus includes a number of recent species brought to light by the deep-sea explorations of late years. It has been found in the Atlantic, the Pacific, and the Eastern Archipelago. The Atlantic species pass into the abyssal zone, but those inhabiting the Pacific and Eastern Archipelago do not, so far as at present known, extend beyond the continental zone, or in other words they live in depths of less than 500 fathoms.

The structure and character of the Cretaceous species described in the following pages, so far as they can be made out from the fragmentary condition of the fossils, appear to me to warrant their inclusion in the genus *Nymphaster*.

1. Nymphaster Coombii, *Forbes*, sp. Pl. VII, figs. 1—3 ; Pl. VIII, figs. 1 *a*, 1 *b*.

Goniaster (Astrogonium) Coombii, *Forbes*, 1848. Memoirs of the Geological Survey of Great Britain, vol. ii, p. 474.

— — — — 1850. In Dixon's Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex, London, 4to., p. 334, pl. xxiii, fig. 6.

— — — *Morris*, 1854. Catalogue of British Fossils, 2nd ed., p. 80.

Astrogonium Combii, *Dujardin and Hupé*, 1862. Hist. Nat. Zooph. Échin. (Suites à Buffon), p. 399.

Goniaster (Astrogonium) Coombii, *Forbes*, 1878. In Dixon's Geology of Sussex (new edition, Jones), p. 367, pl. xxvi, fig. 6.

Body of medium size. Disk moderately large. Rays well produced, rather broad at the base and tapering to the extremity. General form depressed and thin. Marginal contour stellato-pentagonal, the major radius measuring more than twice and a half the minor radius. Marginal plates broad, the supero-marginal series of the two sides of the ray meeting in the median radial line. Interbrachial arcs deeply indented and well rounded. Margin rather thin.

The infero-marginal plates are more than fifteen in number, counting from the interradial line to the extremity. They form a broad conspicuous border to the actinal area, which is relatively broad in proportion to the size of the disk. The largest infero-marginal plates near the median interradial line measure about 5·5 mm. in breadth, and about 2·5 to 2·75 mm. in length. The breadth decreases slightly from this point as the plates approach the base of the ray, and then much more rapidly, the plates on the outer part of the ray having the length considerably in excess of the breadth. The plates are tumid and roundly bevelled at the lateral edges, but are flatly rounded at the margin of the disk, and without tumidity there. The whole superficies of the plate is covered with large, rather deeply depressed, hexagonal punctations, closely placed, which give somewhat of a honeycomb appearance to the plate (see Pl. VIII, fig. 1 *b*). These are the marks left by the granules previously borne upon the plate. Upon a number of the plates in the example figured on Pl. VIII, fig. 1 *a*, the granules are still preserved *in situ*. They are large and closely placed. The punctations, and consequently the granules, in this species are coarser than in any of the other Cretaceous forms known to me. I have not been able to assure myself of the presence in this example of any pedicellariæ on the infero-marginal plates.

The adambulacral plates are broader than long, except on the outer part of the ray, and their armature appears to have consisted of five or six regular series of spinelets. This is indicated by the presence upon the surface of the plate of that number of ridges, running parallel or subparallel to the ambulacral furrow, each having four or five articulatory elevations and intervening pits upon which spinelets had previously been borne. The spinelets were probably short, and similar to those described in *Calliderma Smithiæ* and *Calliderma mosaicum*, but I have not found any preserved in specimens which I consider to be undoubted examples of *Nymphaster Coombii*.

Dimensions.—In the type specimen, figured on Pl. VIII, fig. 1 *a*, the major radius is more than 56 mm., and the minor radius 23 mm. The breadth of the ray between the fourth and fifth infero-marginal plates measures about 15 mm.

Locality and Stratigraphical Position.—The specimen figured is from the Lower Chalk of Balcombe Pit, Amberley. The species has also been obtained from th

Lower Chalk of Glynde, Sussex; as well as from the Lower Chalk of Dover and the Isle of Wight. Other specimens of *Nymphaster*, as to the reference of which to *N. Coombii* I am more or less doubtful, which show certain differences in structural details, are from the Grey Chalk of Folkestone and Dover, and from the Lower Chalk of Betchworth. Several examples in the Museum of Practical Geology, Jermyn Street, are labelled from the "Upper Chalk," but I am inclined to think that their reference to that horizon is more or less doubtful.

History.—The type of this species was found by Mr. G. Coombe at Balcombe Pit, Amberley, and formed part of Mr. Dixon's collection. It is now preserved in the British Museum. It was first figured by Edward Forbes in Dixon's 'Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex,' London, 1850, pl. xxiii, fig. 6. The same specimen is carefully represented on Pl. VIII, figs. 1 *a*, 1 *b* of this memoir.

Doubtful Examples of this Species.—Three specimens are figured on Pl. VII, which I only place provisionally and with very great doubt under this species. I do not, therefore, at present propose to describe them in detail, or to definitely assign the characters they present as supplementary to those already given as belonging to *Nymphaster Coombii*.

1. An example from the Lower Chalk of Betchworth, in which a portion of the actinal surface is preserved (Pl. VII, figs. 1 *a*—1 *e*). This specimen shows large infero-marginal plates somewhat longer in proportion to their breadth than in the type specimen, and their surface is covered with an extremely fine uniform punctation. The latter character is altogether unlike that of examples which I consider to be true forms of *Nymphaster Coombii*. But from this character alone, which recent forms show to be one subject to considerable variation, I shrink from taking any more definite step, at least until further material is available for study. This example has some of the adambulacral plates and actinal intermediate plates well preserved. The adambulacral plates (see Pl. VII, fig. 1 *c*) conform to the description given above. The actinal intermediate plates are rhomboid in form, and their surface is covered with deep, large, well-spaced pits, which indicate the former presence of a coarse uniform granulation. These plates are shown on Pl. VII, fig. 1 *e*. The margin of this example is quite characteristic of *Nymphaster Coombii*. The infero-marginal plates are seen to be low and more or less bevelled or sloping towards the margin; whilst the supero-marginal plates are relatively rather higher and more abruptly bent at the junction of the actinal and lateral surfaces (see Pl. VII, fig. 1 *b*).

2. This is a badly preserved specimen from the Grey Chalk of Folkestone, in which nothing but the supero-marginal plates and the general outline are available

for determination (see Pl. VII, figs. 2 *a*, 2 *b*). The marginal plates resemble in character those of the specimen just mentioned, and they are like them covered with a very fine punctation, unlike that of the typical *Nymphaster Coombii*. There are also fewer plates in that portion of the interbrachial arc which may be said to belong to the disk than in *Nymphaster Coombii*, but as the example is smaller, this may probably be only a question of age; or it may, like the punctation of this and the preceding example, be attributed to variation, which I am disposed to consider a not improbable reason for the differences, when regard is had to the horizon from which the fossils were obtained, and consequently the changed conditions of existence in which those Asterids probably lived.

3. This specimen (figured on Pl. VII, figs. 3 *a*, 3 *b*) is from the Lower Chalk of Glynde, Sussex, and I consider that its reference to *Nymphaster Coombii* is less doubtful than that of either of the two preceding examples. The fragment represents a portion of the abactinal surface. The supero-marginal plates are large, and are covered with the characteristic coarse punctation of *Nymphaster Coombii* (see Pl. VII, fig. 3 *b*). The supero-marginal plates of the two sides of a ray meet in the median radial line from the very base of the ray, distinctly characteristic of the genus *Nymphaster*. Comparing this example with the typical form of the species, there appear to be a much smaller number of supero-marginal plates in the interbrachial arc belonging to the true disk, and on these grounds I hesitate from accepting it positively as an undoubted example of this species until further material is forthcoming to throw light upon the amount of plasticity which may be accredited to this species.

2. NYMPHASTER MARGINATUS, *Sladen*. Pl. VIII, figs. 4 *a*, 4 *b*.

Body of medium size. General form depressed. Marginal contour stellato-pentagonal. Rays well produced, rather broad at the base, and tapering gradually to a pointed extremity. Interbrachial arcs deep and rounded, the sweep of the curve from the tip of one ray to the tip of the neighbouring ray being of a paraboloid character. Margin rather thin.

The supero-marginal plates form a broad and massive border to the abactinal area of the disk. There are six plates on each side of the disk counting from the base of one ray to the base of the neighbouring ray. All the succeeding plates along the ray meet the corresponding plate of the opposite side of the ray in the median radial line. The abactinal surface of the ray is thus occupied entirely by the supero-marginal plates throughout its length.

All the supero-marginal plates are of uniform height, excepting the normal diminution towards the extremity of the ray; and all have the breadth greater than the length. The plates on each side of the median interradial line measure about 4 mm. in breadth and about 2 mm. in length; and this length is maintained with very slight diminution until about midway between the base and the extremity of the ray, where the length is 1·75 mm., and the breadth is between 2·75 and 3 mm. Sixteen supero-marginal plates are preserved in the longest ray of the specimen under description, counting from the median interradial line to the broken extremity. A few plates are apparently missing. Measured in the margin, the height of the plates is about 2·5 mm.

All the supero-marginal plates are distinctly convex in the direction of their median line of breadth, by which each plate is very clearly marked out, and a highly ornate character is given to the species. The plates are also tumid and well rounded on their marginal surface. The whole surface of the plates is covered with rather large, widely spaced punctations or pits, which have a peculiarly isolated appearance, unlike that of any other species (see Pl. VIII, fig. 4 *b*). I have not detected the presence of any pedicellariæ upon this example.

The remains of a few isolated plates are preserved on the abactinal area of the fossil figured. They are all small and out of position, and are not available for description.

Dimensions.—The specimen figured on Pl. VIII, fig. 4 *a*, has a minor radius of about 12 mm.; and the longest fragment of a ray preserved measures about 35 mm. The extremity is wanting. The thickness of the margin is 4·5 mm. The breadth of the ray at the base between the third and fourth supero-marginal plates counting from the median interradial line is from 8 to 8·5 mm.

Locality and Stratigraphical Position.—The example described is from the Upper Chalk near Bromley. It is preserved in the British Museum, and bears the registration number 35,484.

3. NYMPHASTER OLIGOPLAX, *Sladen.* Pl. VIII, figs. 3*a*, 3*b*.

Body of medium size. General form depressed and thin. Marginal contour stellato-pentagonal. Rays narrow at the base and produced. Interbrachial arcs wide and rounded. Margin thin.

The supero-marginal plates form a broad border to the abactinal area of the

disk. There are only three (or possibly four) supero-marginal plates between the median interradial line and the base of the ray—that is to say, about six plates on each side of the disk. The fourth (or perhaps the fifth) plate counting from the median interradial line, and all the succeeding plates along the ray, appear normally to meet the corresponding plate of the opposite side of the ray in the median radial line. The abactinal surface of the ray is thus occupied entirely by the supero-marginal plates throughout its length. In one of the rays preserved there appear, however, to be traces of a few abactinal plates which interfere with the union of the supero-marginal plates in the median radial line near the base of the ray. As to how far this is normal I am unable to say.

All the supero-marginal plates are comparatively low and flat. The plates on each side of the median interradial line are 3·5 mm. in breadth, and from 3 to 3·5 mm. in length, and are thus practically square. Their abactinal surface is slightly convex; and their height as seen in the margin is less than the length, and the abactinal surface is gradually bevelled to the inferior margin which abuts upon the infero-marginal plates. The other plates which form the border of the disk-area are of the same size and character as those adjacent to the median interradial line. The supero-marginal plates along the ray have the breadth greater than the length, the fifth plate counting from the median interradial line measuring about 3·75 mm. in breadth and 2·5 mm. in length. Their character is similar to that of the plates above described. The surface of the plates is covered with small well-spaced punctations, and there is a distinct smooth border on the inner and two lateral margins of each plate on which no punctations or pits are present.

Large trench-like pedicellariæ, which are nearly the length of the plate, are present in this species; they occur more frequently on the infero-marginal plates than on those of the superior series; in fact, only one or two are present on the latter series of plates in the example under description.

No other portions of this fragment are available for description.

Dimensions.—The fragment figured in Pl. VIII, fig. 3 *a*, has a minor radius of about 15 mm. The longest portion of the major radius preserved is about 33 mm., and the ray is broken off abruptly. The thickness of the margin is between 4 and 5 mm. The breadth of the ray at the base is about 8 mm.

Locality and Stratigraphical Position.—The fragment described, which is, unfortunately, all that I have seen, is from the Upper Chalk of Bromley. It is preserved in the British Museum, and bears the registration number 40,178.

Remarks.—The character of the marginal plates, as regards both their form

and their ornamentation, as well as the presence of the peculiar pedicellariæ, and indeed the whole facies of this fossil, lend strong support to the presumption that this species may ultimately need to be placed in a distinct genus, but I do not feel warranted in taking that step on the basis of such scanty material.

Genus—PYCNASTER, *Sladen.*

Disk relatively small and pentagonal. Abactinal surface more or less convex, and was probably somewhat inflated during life. Margin thick, and highest in the region of the disk. Rays elongate, narrow, and robust. Marginal plates forming a broad border to the disk, and united along the median abactinal line of the ray throughout. The marginal plates are high and very robust, those of the superior series being prominently convex abactinally in the median line of breadth and height, which imparts a well-rounded character to the ray. The marginal plates of both series are finely granulated, and probably bore no spines. Actinal intermediate plates large, covered with uniform granules. Armature of the adambulacral plates arranged in longitudinal series. Foraminate pedicellariæ with radiating channels may be present on the marginal plates.

The fragmentary state of the fossils which I have referred to this type unfortunately does not permit of a complete diagnosis of the genus being drawn up. The characters above given appear, however, to me to be sufficient to warrant the recognition of the possessors of them as the representatives of a distinct genus. The small high disk, the massive convex marginal plates, and the large actinal intermediate plates, together with the form of the rays, produce a facies alone sufficient to stamp its individuality, irrespective of other details of structure.

1. PYCNASTER ANGUSTATUS, *Forbes*, sp. Pl. IX, figs. 1 *a*, 1 *b*.

GONIASTER (ASTROGONIUM) ANGUSTATUS, *Forbes*, 1848. Memoirs of the Geological Survey of Great Britain, vol. ii, p. 474.

— — — — 1850. In Dixon's Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex, London, 4to., p. 335, pl. xxiii, fig. 10.

GONIASTER (ASTROGONIUM) ANGUSTATUS, *Morris*, 1854 Catalogue of British Fossils, 2nd ed., p. 80.

ASTROGONIUM ANGUSTATUM, *Dujardin and Hupé*, 1862. Hist. Nat. Zooph.Echin.(Suites à Buffon), p. 399.

GONIASTER (ASTROGONIUM) ANGUSTATUS, *Forbes*, 1878. In Dixon's Geology of Sussex (new edition, Jones), p. 368, pl. xxvi, fig. 10.

Disk of medium size or relatively small and pentagonal. Rays elongate, narrow, robust, and, though tapering, nearly uniform in breadth throughout. Marginal contour stellate. Interbrachial arcs more or less flattened, which emphasises the pentagonal outline of the disk. Margin thick and robust, much highest in the region of the disk. Abactinal surface more or less convex, and was probably somewhat inflated during life. Actinal intermediate plates very large, covered with uniform granules.

The supero-marginal plates are thick and massive, and they form a high and broad border to the disk. There are only three supero-marginal plates between the median interradial line and the base of the ray—that is to say, six plates on each side of the disk. The fourth plate counting from the median interradial line, and all the succeeding plates along the ray, meet the corresponding plate of the opposite side of the ray in the median radial line. The abactinal surface of the ray is thus occupied entirely by the supero-marginal plates throughout its length.

The supero-marginal plates which form the border of the disk are much larger in the direction of height than any of the others. The plates on each side of the median interradial line are about 4·75 mm. in breadth as seen on the abactinal surface, and about the same measurement in length. They are convex abactinally, and well rounded at the junction of the abactinal and lateral surfaces. Measured in the margin their height is 8 mm., and their lateral surface (which forms the vertical wall of the margin) is distinctly convex or pulvinate, but to a less degree than their abactinal surface.

The supero-marginal plates of the ray are not so high as those of the disk, although their height is greater than their length. The height of the sixth plate from the median interradial line is about 5 mm. Their abactinal and lateral surfaces form together a true segment of a circle, and this imparts a well-rounded character to the ray. The plates are deeply bevelled at their junction with the adjacent plates, and consequently distinctly pulvinate in the median line of breadth and height. The surface of the plates is covered with minute punctations, but

these are so extremely faint that they are seen with difficulty. They are probably weather-worn in the example under notice.

The infero-marginal plates, as seen in the direct lateral view of the margin, are much smaller in height than the supero-marginal series in the type specimen. The plates which form the margin of the disk are higher than long, the height being about 5 mm. and the length about 3·25 mm. in those adjacent to the median interradial line; the succeeding plates on the margin of the disk are each less in height than the preceding plate, the third or fourth plate, counting from the median interradial line, having the height and length about equal. The infero-marginal plates along the ray have the length greater than the height. The surface of the infero-marginal plates resembles that of the superior series in the character of its punctation.

Traces of small excavate pedicellariæ are present on occasional plates, but these appear to have been very few in the example under description.

On the abactinal surface of the disk a few isolated and displaced plates are present. Some of these seem rather thick and tuberculous in character, but the state of the preservation of this part of the fossil is unfortunately quite unfitted for description.

There is a fine fragment of this species preserved in the Museum of Practical Geology, Jermyn Street, from the Upper Chalk of Bromley, which shows part of the actinal surface. The infero-marginal plates in the disk are very high in this example, and five of them in an interbrachial arc bear a small foraminate pedicellaria. This is situated near the upper margin of the plate, about equidistant from that margin and the lateral margins of the plate, and consists of a small round foramen situated in the middle of a very shallow concavity, and with five or six faint channels radiating from the foramen to the margin of the concavity, gradually thinning and dying out there. The channels radiate like the spokes of a wheel, or a five-rayed star, and produce a facies unlike that of any other pedicellarian apparatus with which I am acquainted. The actinal intermediate plates are very large, and not more than three series are present. The plates of the series next to the adambulacral plates are much larger than the others, and are broader than long. The adambulacral plates are broader than long, and their surface is marked with three or four ridges parallel to the furrow, upon which spinelets were previously borne. The furrow series consists of about five spinelets. A few of these spinelets are preserved, and they are rather short, cylindrical, and slightly tapering. The mouth-plates are very small and narrow.

Dimensions.—The specimen figured on Pl. IX, fig. 1 *a*, has a minor radius of about 23 mm. The longest portion of a major radius preserved is 53 mm.; the ray is broken abruptly, and there is very slight diminution in the breadth at the

broken extremity as compared with the breadth at the base; there would appear to be every indication that only a small part of the ray is preserved.

The thickness of the margin at the median interradial line is 13 mm., and at the base of the ray 8·5 mm. The breadth of the ray at the base is about 12 mm.

Locality and Stratigraphical Position.—The example above described, which has been drawn on Pl. IX, fig. 1 *a*, was obtained from the Upper Chalk in Kent, but unfortunately the exact locality is unknown. It is preserved in the British Museum. A fine fragment preserved in the Museum of Practical Geology, Jermyn Street, was obtained from the Upper Chalk of Bromley. The species has also been found in the Upper Chalk of Sussex.

History.—The type of this species was first described by Forbes under the name of *Goniaster* (*Astrogonium*) *angustatus*, and was afterwards figured by him in Dixon's 'Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex,' London, 1850, pl. xxiii, fig. 10. That illustration does not, however, give a good idea of the facies of the species.

Genus—PENTAGONASTER, *Linck*, 1733.

PENTAGONASTER,	*Linck.*	De Stellis marinis, 1733, p. 20.
—	*Schülze.*	Betrachtung der versteinerten Seesterne und ihrer Theile, Warschau u. Dresden, 1760, p. 50.
GONIASTER (pars),	*L. Agassiz.*	Prod. Mon. Radiaires, Mém. Soc. Sci. Nat. Neuchatel, 1835, t. i, p. 191.
ASTROGONIUM (pars),	*Müller and Troschel.*	System der Asteriden, 1842, p. 52.
GONIODISCUS (pars),	*Müller and Troschel.*	Ibid., 1842, p. 57.
HOSIA (pars),	*Gray.*	Ann. and Mag. Nat. Hist., 1840, vol. vi, p. 279.
TOSIA,	*Gray.*	Ibid., 1840, vol. vi, p. 281.

Body depressed and pentagonal in contour, or with the rays slightly produced. Marginal plates smooth or granular, ordinarily few in number. Supero-marginal plates form a broad border to the disk, and, when the ray is produced, are separated throughout by abactinal plates. Abactinal area covered with rounded or polygonal plates, which may either be smooth or bear co-ordinated granules. Actinal intermediate plates and infero-marginal plates smooth or granulose, devoid of prominent spinelets.

Much diversity of opinion has existed, unnecessarily it seems to me, as to the

character and limits of this genus. Two species were originally referred to *Pentagonaster* by its founder. The type of one of these is now lost, and its identification rests only on surmise. The second species, however, *Pentagonaster semilunatus*, is a well-known and widely distributed recent form, about which there is no doubt. I therefore consider that this form has every claim to be regarded as the type of the genus. The existing species of *Pentagonaster* are found in the Atlantic, the Pacific, the Indian and the Southern Oceans, and in the Eastern Archipelago; and the bathymetrical range of the genus extends from 20 to 1500 fathoms or more.

1. PENTAGONASTER LUNATUS, *Woodward*, sp. Pl. IV, figs. 1 *a*—1 *c*.

ASTERIAS LUNATUS, *Woodward*, 1833. An Outline of the Geology of Norfolk, p. 52, pl. v, fig. 1.
TOSIA LUNATA, *Morris*, 1843. Catalogue of British Fossils, p. 60.
— — *Bronn*, 1848. Index Palæontologicus, Nomenclator, p. 1274.

Body of medium size. General form depressed. Abactinal and actinal areas flat. Marginal contour stellato-pentagonal, the major radius measuring nearly twice the minor radius. Rays short and moderately produced, rather narrow at the base and tapering to the extremity. Interbrachial arcs deeply indented and well rounded.

The infero-marginal plates are twelve (or more) in number, counting from the median interradial line to the extremity. They form a broad border to the actinal area of the disk, the breadth of which diminishes rather rapidly plate by plate as they recede from the median interradial line. The largest infero-marginal plates adjacent to the median interradial line measure about 5·25 mm. in breadth and about 3 mm. or a little more in length. The length and breadth decrease as each plate proceeds outward until about midway on the ray, where these dimensions are subequal. On the outer part of the ray the length is greater than the breadth. The infero-marginal plates are distinctly convex on their actinal surface in the direction of the median line of breadth, and are slightly tumid at the margin. Their surface is covered with small, uniform, closely placed, and deeply sunken moniliform punctations, upon which small granules were previously borne, probably uniform in size and closely placed (see Pl. IV, fig. 1 *c*). I am not aware that traces of any pedicellariæ have been detected on these plates.

The adambulacral plates are small and oblong, and bear on their surface ridges

g granuliform
the armature of the ad
inal interradial areas are small, and
oid intermediate plates, which are arrang
al furrow, and form a compact, mosaic-like pavement.
plates are moderately large in relation to the size of the disk.
series adjacent to the adambulacral plates are sensibly larger than any o
s, and the plates of the next series are also larger than those which form the
of the pavement. Near the infero-marginal plates the actinal intermediate
es become small and more or less irregular. The intermediate plates extend
the base of the ray to about the fifth infero-marginal plate, counting from the
edian interradial line. The surface of the plates is covered with rather large,
widely spaced, and deeply sunken punctations, upon which granules were pre-
viously borne, and these would appear to have been comparatively large in size and
uniform (see Pl. IV, fig. 1 *b*).

From what is visible of the margin of this example it is seen that the supero-
marginal series of plates are nearly of the same height as the infero-marginal
series, and are similar in structure.

Unfortunately no other portions of this fragment are available for description.

Locality and Stratigraphical Position.—The specimen upon which this species
was founded was collected by Mr. Samuel Woodward, from the Upper White
Chalk, near Norwich.

Dimensions.—In the type specimen (figured on Pl. IV, fig. 1 *a*) the majo
radius is about 35 mm., and the minor radius about 18 mm. Breadth of the r
between the fifth and sixth infero-marginal plates about 10 mm.

History.—The type specimen was figured by Woodward in his 'Outline o
Geology of Norfolk,' pl. v, fig. 1, and is now preserved in the collection
Norfolk and Norwich Museum. It was kindly lent by the committee
institution to Dr. Wright for the purpose of this monograph. It h
carefully drawn on Pl. IV, figs. 1 *a*—1 *c*. An admirably executed cas
specimen is in the British Museum. I am not at present aware of the
of any other examples of this rare form.

Remarks.—The example referred by Forbes to this species, an
Geology and Fossils of the Tertiary and Cretaceo
pl. xxiii, fig. 9, belongs to a distinct sp
plax. A number of other spe

collections have, following Forbes, been erroneously referred to *Pentagonaster lunatus*, which are in reality examples of *Pentagonaster megaloplax*. This is unfortunate, for the latter form has thus become comparatively well known under the name of *Pentagonaster lunatus*, a name which they must now cease to bear, as the real *Pentagonaster lunatus* is quite a different form, and there is no doubt whatever either as to the type (which is preserved in Norwich) or the priority. The differences between the two species will be further noticed under the description of *Pentagonaster megaloplax*.

2. PENTAGONASTER MEGALOPLAX, *Sladen*. Pl. IV, figs. 2—4.

GONIASTER (ASTROGONIUM) LUNATUS, *Forbes*, 1850. In Dixon's Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex, London, 4to., p. 353, pl. xxiii, fig. 9 (non *Asterias lunatus*, Woodward, 1833).

Body of medium size. General form depressed. Abactinal and actinal areas flat. Marginal contour stellato-pentagonal, the major radius measuring a little more than once and a half the minor radius. Rays short and not greatly produced, tapering gradually to the extremity. Interbrachial arcs regularly rounded, curving gradually from the tip of one ray to that of the adjacent ray, which gives a distinctly lunate character to the disk. Margin of uniform thickness.

The infero-marginal plates are only five or rarely six in number, counting from the median interradial line to the extremity. They form a very broad border to the actinal area of the disk in relation to its size, and the breadth is maintained until near the extremity. The largest infero-marginal plates adjacent to the median interradial line measure 7 mm. in breadth, and about 6·5 mm. or nearly 7 mm. in length; they are consequently almost square. The proportion of breadth diminishes in the succeeding plates as they recede from the median interradial line. The infero-marginal plates have a more or less pulvinate appearance actinally, consequent on being rounded or bevelled at the edges; and they are slightly tumid in the margin. Their whole actinal surface is covered with large, well-spaced, deeply sunken pits, in the centre of which is a slight eminence—a structure which has almost the character of a granule surrounded by a scrobicule (see Pl. IV, fig. 2 *b*). On the surface which stands in the margin the punctations are fewer and more widely spaced on the upper half of the surface—that is to say,

the half adjacent to the supero-marginal series (see Pl. IV, fig. 4 *c*). I have not found any pedicellariæ on these plates.

The adambulacral plates are broader than long, except on the outer part of the ray, and bear on the surface four or five ridges with granuliform eminences, upon which the spinelets constituting the adambulacral armature were originally borne. In one well-preserved specimen these small articulatory tubercles are seen to have each a small microscopic central puncture (see Pl. IV, fig. 3 *c*), but I am not certain whether this is always present.

The actinal interradial areas are small, and are covered with a comparatively small number of large pentagonal or tetragonal intermediate plates, which are arranged in series parallel to the ambulacral furrow, and form a compact tessellated pavement. The actinal intermediate plates are larger in relation to the size of the disk than in the species above described. The plates of the series adjacent to the adambulacral plates, and a few of the plates of the succeeding series within the angle towards the mouth, are larger than the others. The intermediate plates do not extend beyond the second, or at most a short distance along the margin of the third infero-marginal plate, counting from the median interradial line. The surface of the intermediate plates, excepting a border round the margin of the plate, is covered with large punctations, which are nearly confluent, and in some cases almost give the appearance of a coarse reticulate superficial ornamentation; the border round the margin of the plate above mentioned is marked with a concentric crenulation (see Pl. IV, fig. 3 *b*). Within the pits are more or less definite elevations. In other examples the reticulate character is less marked, and the margin of the pit is then prominently lipped, and the marginal crenulation is not so strongly shown (see Pl. IV, fig. 4 *e*).

In the marginal view of the type specimen the supero-marginal plates are seen to be higher than the infero-marginal plates, and that their height is greater than their length, whereas in the infero-marginal series of plates the height is less than the length (see Pl. IV, fig. 2 *c*).

In other examples the mouth-plates are preserved. These are rather small, triangular, and covered with rather large, irregular, tuberculose eminences for the attachment of the mouth-plate armature.

Variations.—Three examples of this species are figured on Plate IV. These present a number of minor differences, which will be readily noticed on referring to the figures.

The example which is shown in fig. 3 *a* has the marginal border of the infero-marginal plates rather less broad than in the type form, and it is especially remarkable for the peculiar retiform and crenulated ornamentation of the actinal intermediate plates already noticed. The disposition of the armature of the

PLATE I.

CALLIDERMA SMITHIÆ, *Forbes*, sp. (P. 6.)

From the Lower Chalk.

FIG.

1 *a*. Actinal aspect; natural size. (Coll. Brit. Mus.)
b. Lateral view of the margin; natural size.
c. Infero-marginal plates; magnified 2 diameters.
d. Lateral view of the marginal plates; magnified.
e. Adambulacral plates; magnified.
f. Actinal intermediate plates; magnified 3 diameters.

PLATE II.

CALLIDERMA LATUM, *Forbes*, sp. (P. 12.)

From the Lower Chalk.

FIG.

1 *a*. Actinal aspect; natural size. (Coll. Brit. Mus.)

b. Infero-marginal plates; magnified 2 diameters.

c. Actinal intermediate plates; magnified 3 diameters.

d. Adambulacral plates; magnified.

e. A mouth-plate; magnified.

a. Actinal aspect of another example, with a portion of the actinal floor removed, showing the stellate bases of the abactinal plates or paxillæ; natural size. (Coll. Brit. Mus.)

b. Actinal surface of part of the ray; magnified 1½ diameters.

c. Infero-marginal plates; magnified 3 diameters.

d. Stellate bases of the abactinal plates or paxillæ; magnified 4 diameters.

1b.

1c.

1d.

1e

2b.

2c.

2d.

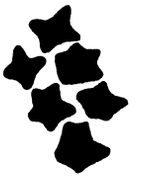


PLATE III.

CALLIDERMA LATUM, *Forbes*, sp. (P. 12.)

From the Lower Chalk.

FIG.

1 *a*. Actinal aspect of an example from Amberley; natural size. (Coll. Brit. Mus.)

b. Lateral view of the margin; natural size.

c. Lateral surfaces of the marginal plates; magnified.

d. An infero-marginal plate; magnified.

e. An actinal intermediate plate; magnified.

2 *a*. Actinal aspect of an example from the Chalk Marl of Dover; natural size. (Coll. Brit. Mus.)

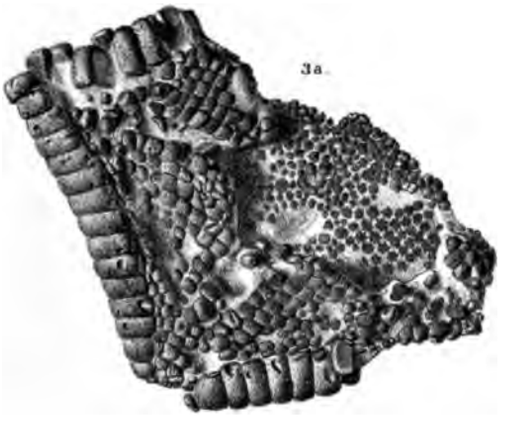
b. An adambulacral plate; magnified.

3 *a*. Actinal aspect of an example from Washington, with a portion of the actinal floor removed, showing the stellate bases of the abactinal plates or paxillæ; natural size. (Coll. Brit. Mus.)

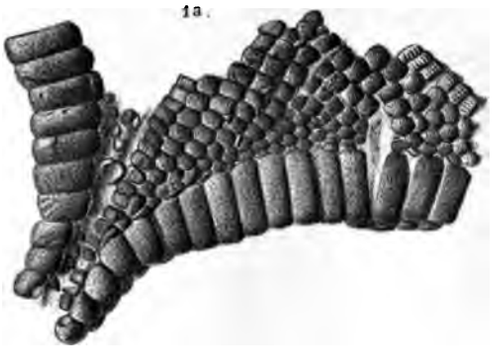
b. Stellate bases of the abactinal plates or paxillæ; magnified.

3b.

3a.



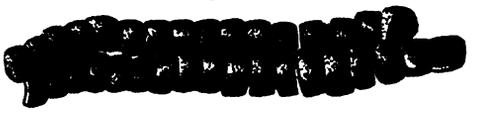
1a.



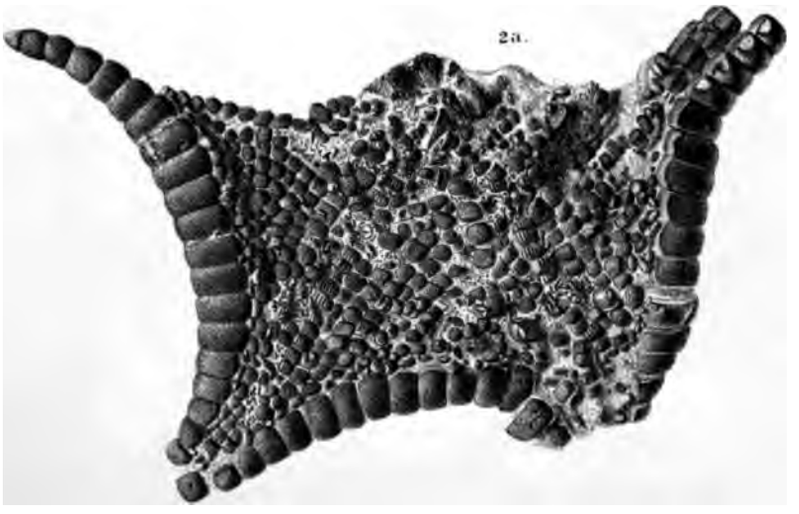
1d.

1c

1b.

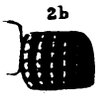


2a.



1e.

2b



Hanhart imp.

A.H.Searle del.et lith .

PLATE IV.

PENTAGONASTER LUNATUS, *Woodward*, sp. (P. 25.)

From the Upper Chalk.

FIG.

1 *a*. Actinal aspect of the type specimen; natural size. (Coll. Norfolk and Norwich Mus.)

b. An actinal intermediate plate; magnified.

c. An infero-marginal plate; magnified.

PENTAGONASTER MEGALOPLAX, *Sladen*. (P. 27.)

From the Lower Chalk.

2 *a*. Actinal aspect of the example figured by Forbes, under the name of *Goniaster* (*Astrogonium*) *lunatus*; natural size. (Coll. Brit. Mus.)

b. An infero-marginal plate; magnified 3 diameters.

c. Lateral view of the margin; natural size.

3 *a*. Actinal aspect of another example; natural size. (Coll. Brit. Mus.)

b. An actinal intermediate plate; magnified 6 diameters.

c. Adambulacral plates; magnified 6 diameters.

4 *a*. Actinal aspect of an example from the Upper Chalk of Bromley; natural size. (Coll. Brit. Mus.)

b. Lateral view of the margin; natural size.

c. Lateral surface of an infero-marginal plate; magnified.

d. An infero-marginal plate; magnified.

e. An actinal intermediate plate; magnified 6 diameters.

PLATE V.

Tomidaster sulcatus, *Sladen.*

From the Grey Chalk.

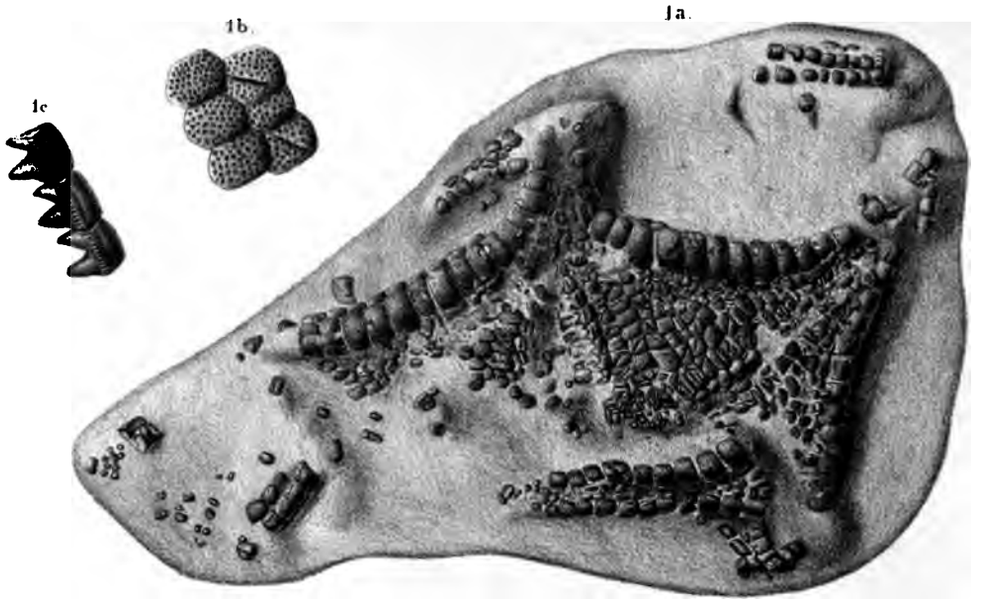
Fig.

1 *a*. Actinal aspect; natural size. (Coll. Brit. Mus.)
b. Actinal intermediate plates; magnified.
c. Adambulacral plates; magnified 3 diameters.

Calliderma mosaicum, *Forbes*, sp. (P. 9.)

From the Lower Chalk.

2 *a*. Abactinal aspect; natural size. (Coll. Brit. Mus.)
b. Lateral view of the margin; natural size.
c. Abactinal plates; magnified.
d. Supero-marginal plates; magnified.
e. Madreporiform body and surrounding plates; magnified.


1a.
1b.
1c

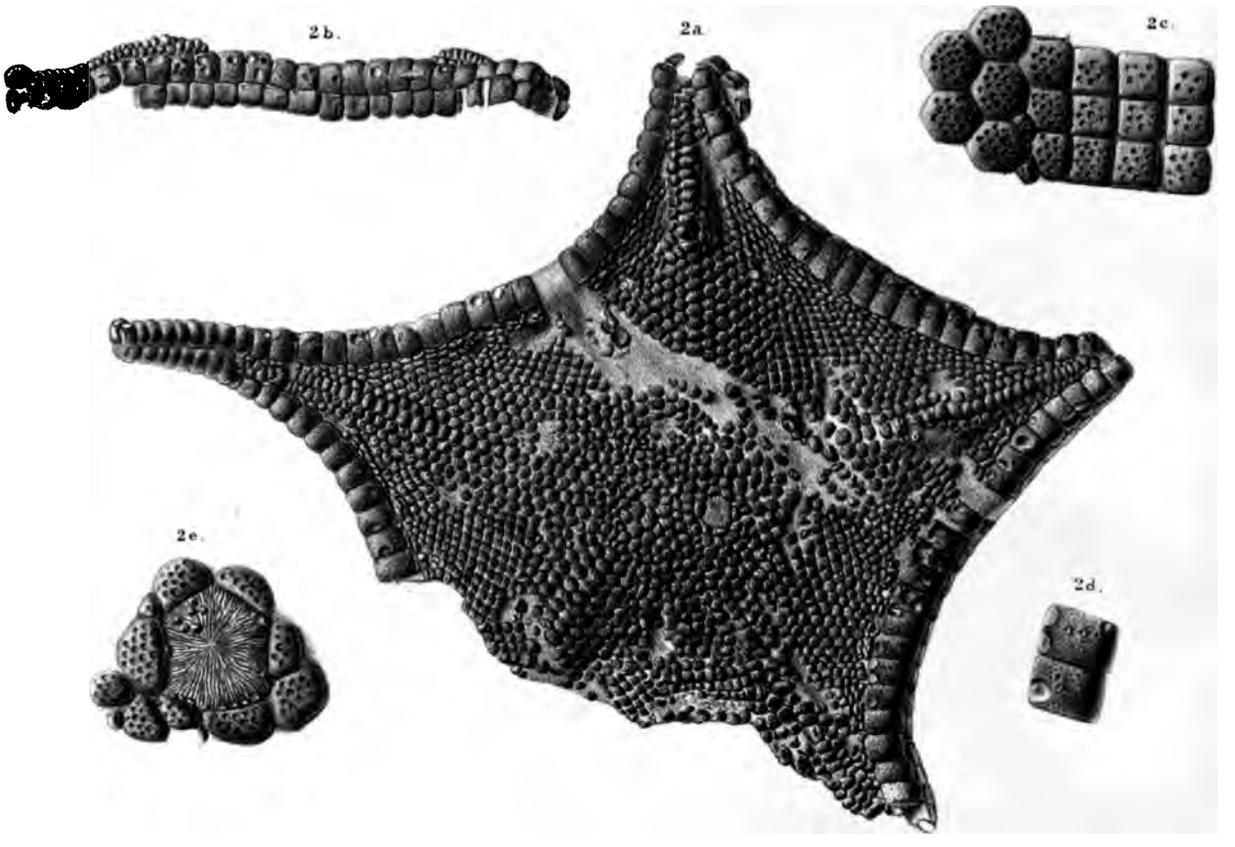

2a.
2b.
2c.
2d.
2e.

PLATE VI.

CALLIDERMA MOSAICUM, *Forbes*, sp. (P. 9.)

From the Grey Chalk.

FIG.

1. Abactinal aspect of an example from which the abactinal plates have been removed; natural size. (Coll. Brit. Mus.)

2 *a*. Abactinal aspect of another example from which the abactinal plates have been removed, showing the inner surface of some of the actinal intermediate plates and adambulacral plates; natural size. (Coll. Brit. Mus.)

b. Adambulacral plates, seen from within; magnified.

c. Actinal intermediate plates, inner surface; magnified.

1.

2c.

2b.

2a.

PLATE VII.

(?) NYMPHASTER COOMBII, *Forbes*, sp. (P. 15.)

From the Lower Chalk.

FIG.

1 *a*. Actinal aspect; natural size. (Coll. Brit. Mus.)
b. Lateral view of the margin; natural size.
c. Adambulacral plates; magnified.
d. An infero-marginal plate; magnified.
e. Actinal intermediate plates; magnified.

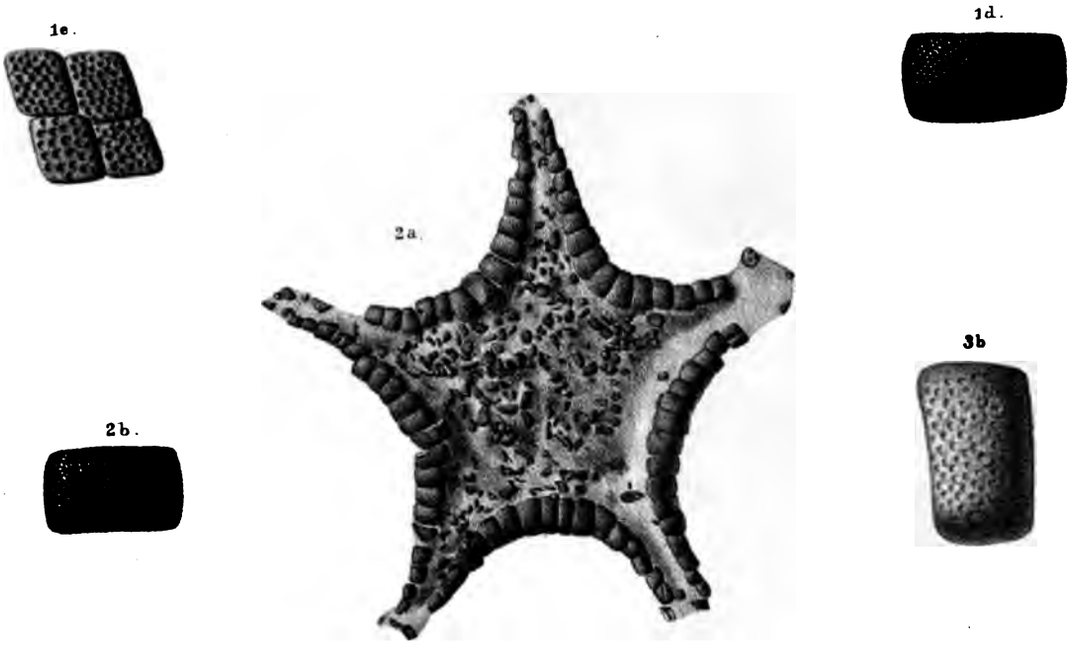
2 *a*. Abactinal aspect of an example from the Grey Chalk at Folkestone; natural size. (Coll. Brit. Mus.)
b. A supero-marginal plate; magnified.

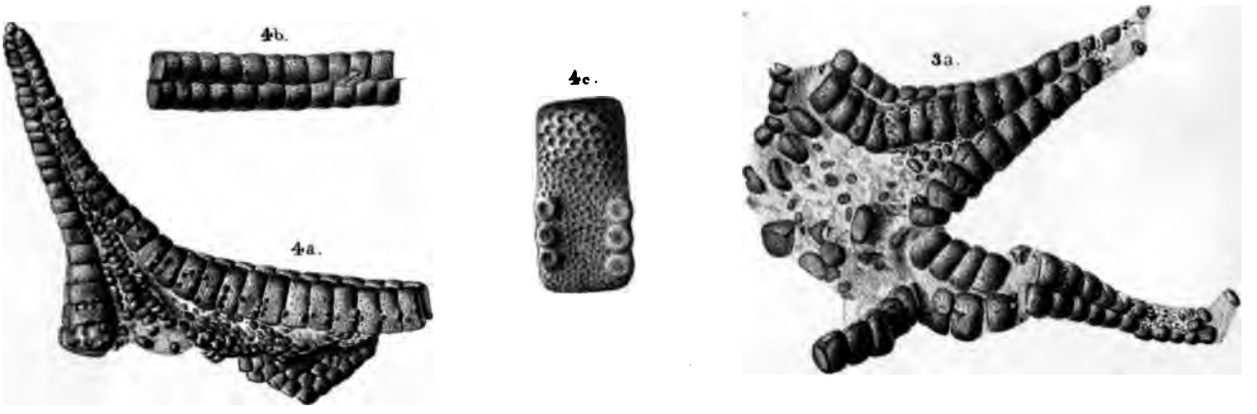
3 *a*. Abactinal aspect of an example from the Lower Chalk of Glynde; natural size. (Coll. Brit. Mus.)
b. A supero-marginal plate; magnified.

CALLIDERMA MOSAICUM, *Forbes*, sp. (P. 9.)

From the Lower Chalk.

4 *a*. Abactinal aspect; natural size. (Coll. Brit. Mus.)
b. Lateral view of the margin; natural size.
c. A supero-marginal plate; magnified.





AH.Searle del. et lith.

Hanhart imp.

PLATE VIII.

NYMPHASTER COOMBII, *Forbes*, sp. (P. 15.)

From the Lower Chalk.

FIG.

1 *a*. Actinal aspect of the type specimen; natural size. (Coll. Brit. Mus.)
b. An infero-marginal plate; magnified 3 diameters.

CALLIDERMA SMITHII, *Forbes*, sp. (P. 6.)

From the Lower Chalk.

2 *a*. Profile view of a fragment of a ray; natural size. (Coll. Brit. Mus.)
_b_. Actinal view of the same; natural size.
_c_. An adambulacral plate; magnified 6 diameters.

NYMPHASTER OLIGOPLAX, *Sladen*. (P. 19.)

From the Upper Chalk.

3 *a*. Abactinal aspect; natural size. (Coll. Brit. Mus.)
b. A supero-marginal plate; magnified.

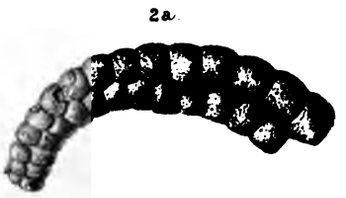
NYMPHASTER MARGINATUS, *Sladen*. (P. 18.)

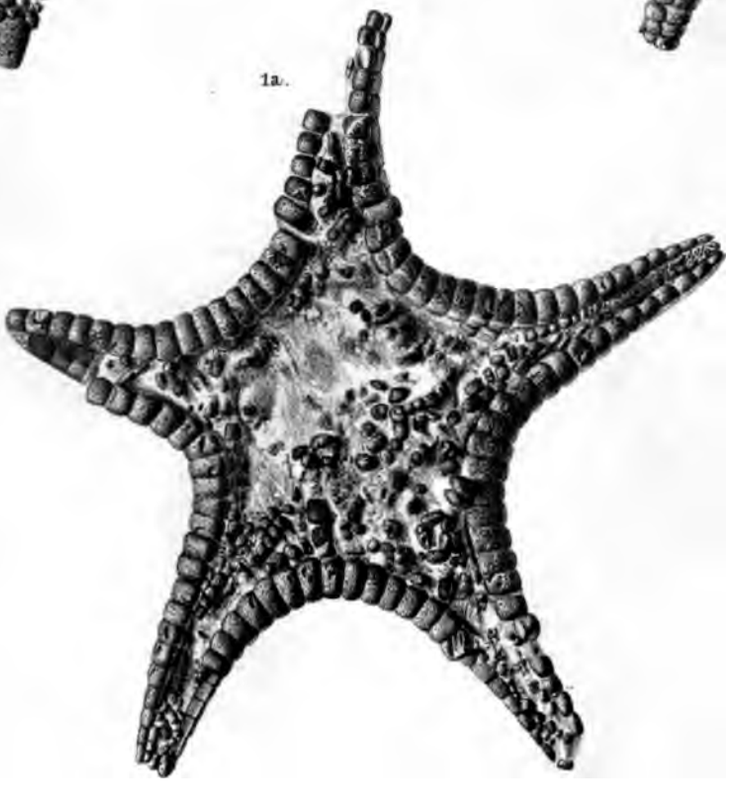
From the Upper Chalk.

4 *a*. Abactinal aspect; natural size. (Coll. Brit. Mus.)
b. A supero-marginal plate; magnified 4 diameters.

2c.

2b.


2a.

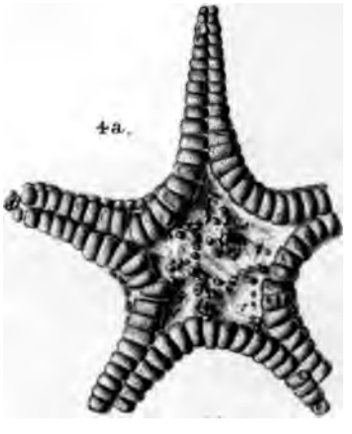

1a.

3b.

1b.

3a.

4b.


4a.

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THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

VOLUME FOR 1890.

LONDON:
MDCCCXCI.

A MONOGRAPH

ON THE

INFERIOR OOLITE AMMONITES

OF

THE BRITISH ISLANDS.

BY

S. S. BUCKMAN, F.G.S.

PART V.

PAGES 225—256; PLATES XXXVII—XLIV.

LONDON:

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

1891.

PRINTED BY
ADLARD AND SON, BARTHOLOMEW CLOSE.

Family—ARIETIDÆ, *Hyatt.*

Genus—HUDLESTONIA,[1] *S. Buckman.*

(*Type*—HUDLESTONIA AFFINIS, *Seebach* sp.)

1878. AMALTHEUS, *Neumayr.* Unvermittelt auftretende Ceph.; Jahrbuch k.-k. geol. Reichsanstalt, Bd. xxviii, Heft 1, p. 61 (group *Oxynoti* in part).

1884. OXYNOTICERAS, *Zittel* (non *Hyatt*). Ceph.; Handbuch der Pal., Bd. i, Abth. 2, Lief. 3, p. 450 (in part).

1889. PELECOCERAS, *S. Buckm.* (non *Hyatt*). Cotteswold, &c., Sands; Quart. Journ. Geol. Soc., vol. xlv, p. 450, &c.

1890. — — — This Monograph, *antea.*

Adult: Discoidal, compressed, fairly involute. Whorls broad, sloping to form an acute ventral area. Suture-line very simple, lobes short and broad, denticulations very slight. Young: Whorls ornamented with radii sometimes bifurcating to form primary and secondary ribs. Ventral area more pronounced, with a small (hollow ?) carina. Sutures with lobes more pronounced.

Only a few species are included in this genus. They are mostly deficient in ornamentation, and are separable one from another chiefly by the amount of involution or the extent of compression attained. As may be seen from the plate, the material with which I have had to deal has been most unsatisfactory; and, therefore, it is impossible to be very definite in my remarks.

The species included in this genus have undergone several changes in regard to their generic classification. Originally placed in the genus *Amaltheus*—a genus with which they have nothing in common except a sharpened ventral area, a character of no generic value at all—they were removed by Zittel to the genus *Oxynoticeras*. With this genus they have many points in common; but the inner whorls of the specimens indicate a certain difference of origin, and I have consequently proposed a new generic name. At one time I thought that they might be the species for which Hyatt created the genus *Pelecoceras*, the description of which seemed to fit them fairly well; but correspondence with Prof. Hyatt has resulted in my ascertaining that this genus was proposed for something quite different.[2]

[1] In compliment to my kind friend Mr. W. H. Hudleston, F.R.S., &c.

[2] Prof. Hyatt writes to me that "*Pelecoceras attenuatum*, Hyatt, is, if not identical, very similar to the *Am. malagma* of Dum." (see pp. 142, *et seq.*). On my pointing out to Prof. Hyatt

The descent of the genus *Hudlestonia* is very uncertain, because of the paucity of the badly-preserved material which I have had to examine; but the general shape and the suture-line suggest affinity with *Oxynoticeras*. Now, Hyatt derives *Oxynoticeras* directly from *Agassiceras striaries*, and places the genus in the family *Arietidæ*.[1] I am almost inclined to think that there is an intermediate stage of development, of which all trace is omitted in *Oxynoticeras* on account of the very early inheritance of *Oxynoticeratan* characters; and this stage may be mentioned as *Amm. obtusus—stellaris—impendens—Collenotii*, Wright—*Collenotii*, d'Orbigny (*Simpsoni*, Wright)—*oxynotus*. The changes in this series are increase of involution and consequent broadening of lateral area—decrease of ribbing—compression of ventral area, with consequent gradual loss of ventral furrows, ending in an acute carina.

The development of the genus *Hudlestonia* seems to be almost parallel to this, and appears to furnish strong evidence in support of the above view concerning *Oxynoticeras*. *Hudl. Sinon* may be taken as analogous to *Am. Collenotii*, Wright, in the matter of its ribbing, &c.; but *Hudl. serrodens*, which is analogous to *Oxynot. oxynotum*, shows no trace of this ribbing, &c.,[2] in its inner whorls—in fact, the *Sinon*-stage is omitted in *Hudl. serrodens* on account of the very early inheritance of the smooth characters. The inner whorls of *Hudl. affinis* (Pl. XXXVIII) show the connection of *Hudl. serrodens* with *Hudl. Sinon*, and indicate that *Hudlestonia* was derived from an Ammonite bearing considerable resemblance to *Arnioceras* except in lacking furrows; and the absence of furrows may of course be due to development.

Further than this it is impossible to go with the poor material at command; but I think there is sufficient evidence to warrant the conclusion that *Hudlestonia* is a developed form of a branch of the Arietidæ, say *Arnioceras*, and is analogous to *Oxynoticeras*—in other words, that it is a later development from the same or nearly similar stock whence *Oxynoticeras* was derived, and that it went through very similar phases of development with similar results. The young forms of the genus show by their ribbed whorls and, comparatively-speaking, large umbilicus that *Hudlestonia* is not descended directly from *Oxynoticeras;* and the umbilicus, again, prohibits the idea that they come from *Am. Guibali*, whose ancestors, by the

that practically his genus *Pelecoceras* and my genus *Haugia* are identical, he kindly wrote in reply, "I noticed that you had separated the *Variabilis*-group from *Hammatoceras* by name of *Haugia*. . . . . It is curious that while I separated *Pelecoceras* I did not separate *Variabilis* itself from *Hammatoceras*. I do not think, therefore, that my name *Pelecoceras* has any proper title to supersede your *Haugia*." I take this opportunity to tender my sincere thanks to the learned Professor for his constant courtesy.

[1] "Genesis of the Arietidæ," 'Smithsonian Contributions to Knowledge' (4to.), vol. xxvi, p. 214, 1889.

[2] That is according to Quenstedt's figure. I can say nothing from my own specimens.

way, were probably not the same as those of *Oxynot. oxynotum*. It is on these grounds, as I have said, that I create the genus *Hudlestonia*.

The broad, shallow, little-denticulated lobes of this genus distinguish it at once from any of the previously described genera; and this feature separates *Hudl. Sinon* from either *Gramm. aalense, Ludwigia Murchisonæ*, or any other species which are ornamented with bifurcate radii. The suture-line of this genus, it may be remarked, is decidedly Arietan in character; and its shallow lobes—which become more shallow as development proceeds—are caused by the extension of the lateral area, producing, as it were, a stretching of the suture-line.

The British species of *Hudlestonia* have been derived from one particular horizon, namely, the *Jurense*-zone; and in the Cotteswolds they are confined to the *Dumortieria*-beds. A form from the *Opalinum*-zone—"upper part of *Trigonia-navis*-beds or lower part of beds with *Am. Murchisonæ*"[1]—namely, *Am. Fredericii*, Branco, which is almost identical with *Am. serrodens*, is the only species of the genus which I cannot record in this Monograph.

HUDLESTONIA SINON (*Bayle*). Plate XXXVIII, figs. 13—16.

1846. AMMONITES MURCHISONÆ, *Schmidt* (non *Sowerby*). Petrif.-Buch, pl. xxxv, figs. 2 *a*, *b* (not 2 *c*, *d*).
1874. — COSTULA, *Dumortier* (non *Reinecke*). Études pal. Bassin Rhône, iv, pl. li, figs. 1, 2.
1878. LUDWIGIA SINON, *Bayle*. Explic. carte géol. France, vol. iv, pt. 1, pl. lxxxiii.
1885. HARPOCERAS SINON, *Haug*. Beitr. Monogr. Harpoceras; Neues Jahrbuch für Mineral., &c., Beil.-Bd. iii, p. 669.

Discoidal, compressed, carinate. Whorls broad, ornamented with subsigmoidal, ventrally-inclined, primary and secondary radii; primary radii situated on the inner third of the whorls, and bifurcating or trifurcating to form the secondary radii; radii disappear in adult. Ventral area undefined, slightly carinate on core (no hollow carina?); in adult age no ventral area, the compression of the sides forming a carina. Inner margin sloped, slightly convex. Inclusion about two-thirds.

One extremely poor cast is all the material I have seen. It is even doubtful if it exactly represent Bayle's species; but his figure is certainly the nearest form. As this specimen only differs in certain minor points, I could not think of making a new species on such material; but the following points should be noticed. Bayle's fig. 1 has a slightly smaller umbilicus than the specimen before me; its

[1] Branco, "Unt. Dogger Deutsch-Lothringen," 'Abh. z. geol. Spez.-Karte,' Bd. ii, pl. iii, 1879.

inner margin is represented as slightly concave; and its sutures have a longer superior-lateral lobe. No front view is given; but the front view of his fig. 3 certainly seems to represent a thicker fossil.

Taking Zieten, pl. vi, fig. 1, as the type of Mayer's *Am. opalinoides*, there is certainly considerable resemblance between "*opalinoides*" and "*Sinon*," but the ventral area of the latter is evidently much more acute, and the ribs are stronger.

The most interesting fact about *Hudl. Sinon* is the manner in which its outer whorl prefigures the other species of the genus. It is easy to imagine *Hudl. serrodens* as the descendant of this species, although it is more probably derived from *Hudl. affinis*. The specimen figured (Pl. XXXVIII, figs. 13—16) is in the collection of Mr. W. H. Hudleston, F.R.S., who kindly lent it, and others, for this work. It came from the Grey Sands, Blue Wyke, Yorkshire.

HUDLESTONIA AFFINIS[1] (*Seebach*). Plate XXXVIII, figs. 1—8.

1864. AMMONITES AFFINIS, *Seebach*. Der hannoverische Jura, pl. viii, figs. 4 *a*, *b*.

Adult: Discoidal, compressed, carinate. Whorls with strongly gibbous sides, their convexity interrupted near the ventral edge by a slight depression. Ventral edge narrow, slightly rounded. No defined inner margin. Inclusion apparently about three-fourths of preceding whorl. Sutures simple with broad lobes.

Young: Whorls ornamented with subsigmoidal, ventrally-inclined radii, which are sometimes united on the inner area, forming a coarser rib. Ventral area more pronounced, with a carina on the core.

The material of this species is not only lamentably fragmentary, but is in the form of poor casts. In sectional view the whorls differ somewhat from Seebach's figure, being less convex altogether, and especially near the inner margin. In Seebach's figure the whorls are more pear-shaped in section; in our specimens they are almost lanceolate.

The forms figured by Brauns and Schloenbach[2] do not seem to me to represent Seebach's species. Schloenbach's figure, especially, appears to be much too compressed and too involute, and in this respect closely resembles *Hudl. serrodens*. Brauns' figs. 1, 2, appear to have the same features; but his outline fig. 3 is rather gibbous, although not so gibbous as Seebach's. Of course, as *Hudlestonia serrodens* is probably only the compressed, involute development of

[1] The name "*affinis*," "near to," probably refers to its relationship to *Am. serrodens*.

[2] See the synonyms of *Hudl. serrodens*.

1874. AMMONITES SERRODENS, *Dumortier*. Études pal. Bassin Rhône, pl. lviii, figs. 2, 3.
1885. — — *Quenstedt*. Amm. Schwäbischen Jura, pl. xlviii, figs. 15—17.

Discoidal, compressed, carinate. Whorls sloping from the upper edge of the inner margin to form a sharp, knife-like ventral area. Inner margin fairly steep. Inclusion nearly the whole whorl. Umbilicus small and rather deep. Suture-line simple, the lobes broad with very small denticulations.

The specimens are very poorly preserved, and lack the test entirely. They are also decidedly inferior as casts—there is no sharpness about them; they are generally more or less crushed, and a whole whorl is a rarity. On account of these reasons I have contented myself with outline figures, which will convey sufficient idea of the shape. The test was apparently ornamented with fine arcuate growth-lines, but there are only occasional indications of them upon the cast. The smaller umbilicus and the absence—judging from Quenstedt's figure—of ribs in the inner whorls are the features which separate this species from *Hudl. affinis*.

From *Am. Fredericii*, Branco, which, however, is for all practical purposes the same species, it only differs by its less pronounced inner margin. Branco cites the simpler lobes as a character distinguishing his species; but they do not possess much value, because the lobes of *Hudl. serrodens* become simpler as the specimens become older or more developed. Dumortier's figure of *serrodens* (*loc. cit.*) is evidence on this point.

From *Oxynoticeras oxynotum* of the Lower Lias, and from *Ammonites discus* of the Cornbrash, to both of which it bears considerable external resemblance, *Hudl. serrodens* may be known by its suture-line, as well as by other features. It may possess a certain collateral relationship to the first named, but must be very remote from the latter. The inclusion of these and many other similar-shaped species in the same genus was caused by a failure to observe that they were polygenetic—that they were, in fact, nothing more than forms resulting from senile degradation of different branches.

Quenstedt's figures represent *Hudl. serrodens* without any ribs on the inner whorls. If this be correct, it means that, by very early inheritance of the smooth character of *Hudl. Sinon* or *Hudl. affinis*, this species has omitted the ribbed stage altogether. From which of the two above-mentioned species this one is derived cannot be stated with any degree of certainty; but it is true enough that in *Hudl. Sinon, affinis, serrodens,* we have, in this order, three stages of development; and the amount of development is indicated by the ever earlier period at which the smooth, senile character is introduced.

The upper part of the *Jurense*-zone (*Dumortieria*-beds) is the horizon of this

species in the Cotteswolds. The specimen from which the outlines (figs. 9, 10) were taken came from Penn Wood, near Stroud; and fragments have been collected at Cam Down, North Nibley, and Wootton-under-Edge.

From the *Dispansum*-beds of White Lackington, near Ilminster, I obtained a poor fragment.

Pl. XXXVIII, fig. 9, is the outline of the side view of a very inferior specimen of this species; fig. 10 is its aperture; and fig. 11 its suture-line. It came from Penn Wood, near Stroud. Fig. 12 shows the aperture of a fragment from Cam Down, near Dursley. This aperture differs somewhat in shape from fig. 10, but then the specimen is much smaller.

Family—POLYMORPHIDÆ, *Haug*.

Genus—DUMORTIERIA, *Haug*.

(*Type*—DUMORTIERIA LEVESQUEI, *d'Orbigny* sp.)

1885. DUMORTIERIA, *Haug*. Beitr. Monogr. Harpoceras; Neues Jahrbuch für Mineral., &c., Beil.-Bd. iii, p. 666.

1887. — — "Polymorphidæ;" Neues Jahrbuch für Mineral., &c., Bd. ii, p. 147.

Discoidal, compressed, fairly evolute. Whorls ornamented with ribs, straight or nearly straight on the lateral area,[1] slightly projected forwards on the ventral area. Ventral area more or less carinate. Mouth furnished with a long lateral process and a slight pointed ventral projection. Suture-line fairly ornate, lobes rather long and saddles rather deep. The inner part of the suture-line, including the rather small inferior lateral lobe, somewhat dependent—that is, the lobes pointing across the whorl towards the carina.

The species of Ammonites which compose the genus *Dumortieria* appear to me to possess unusual interest; and yet they have attracted but little attention in this country. I attribute this want of notice, first, to their generally inferior preservation, as well as comparative scarcity; and secondly, to their having probably passed as belonging to other species of Ammonites—species now separated into the genus *Grammoceras*.

[1] These ribs will be described as direct (= straight) or subdirect (= nearly straight) ribs, ventrally inclined—that is, with a short ventral projection, not a long ventral projection (= ventrally projected) as in *Grammoceras*.

One of the most interesting points in connection with the genus *Dumortieria* is what may be called the "archaic" character of the "less-developed" shells. The more or less rounded whorls, the straight ribs, and the slightly-carinate ventral area take us back to the much earlier (Lower-Lias) forms of *Ophioceras*;[1] and Hyatt rightly enough appreciated this when he placed *Am. Levesquei* in the genus *Ophioceras*.[2]

The genera *Dumortieria* and *Grammoceras* have, superficially, a very great resemblance; but their descent is certainly distinct. This, however, is a matter which can only be learnt by the examination of a large series of species. When dealing with single specimens, and wishing to determine their genus, the reader should consult page 162, and remember that the characteristics of *Dumortieria* are ribs straight on the lateral area and very little projected ventrally, long siphonal and superior lateral lobes, the inner portion of the suture-line brought down obliquely (dependent).[3]

The origin of the genus *Dumortieria* may be traced to a smooth species, say *Agassiceras miserabile*[4] in the *Obtusum*-zone. This species gave rise to the smooth *Polymorphites polymorphus*, which passed into *Pol. polymorphus lineatus* with fine ribs, and into *Pol. polymorphus costatus* with stronger and more distant ribs. This development, carried on in the same manner, would produce *Catulloceras Vernosæ* (Zittel), a species with well-marked ribs but no carina. Now, this species occurs in the *Margaritatus*-zone; and it should be noticed that its development from the smooth *Pol. polymorphus* is exactly parallel to the changes which, in the Lower Lias, produced such species as *Am. carusense*, d'Orbigny, or *Am. planicosta*, Sowerby, from a smooth ancestral form.

Between *Catulloceras Vernosæ* of the Middle Lias, and the species of *Catulloceras* and *Dumortieria* of the *Jurense*-zone, is a break, during which no species of the genus can be recorded; and, therefore, the changes necessary to produce the *Jurense*-zone species from the Middle-Liassic ancestor must be matters of hypothesis. The great similarity between *Dumortieria prisca* and *Catulloceras Dumortieri* favours the view of their derivation from a common, and not very remote, source. The addition of a carina on the ventral area cutting across the ribs would convert *Catulloceras Vernosæ* into *Catull. Dumortieri*. To evolve *Dum. prisca*, however, more changes must have taken place. First, the ribs of *Catull. Vernosæ* are coarser and more distant on the outer than on the inner whorls, and the supposed

[1] See *Arg. liassicum, intermedium, Belcheri*, figured by Dr. Wright, 'Lias Amm., Pal. Soc.,' pl. xv. These species are now described as *Caloceras*; Hyatt, "Genesis of Arietidæ," 'Smithsonian Contributions to Knowledge' (4to.), vol. xxvi, p. 141, 1889.

[2] Hyatt, 'Bull. Mus. Comp. Zool.,' No. 5, p. 93.

[3] At p. 162, line 23 from top, "practically no inferior lateral lobe" is not quite correct. It is better to say "small inferior lateral lobe."

[4] See, however, Haug, "Polymorphidæ," 'Neues Jahrbuch für Mineral.,' &c., Bd. ii, 1887.

descendants must have continued to accentuate this feature until, on their outer whorls, something resembling the distant ribbing of the inner whorls of *Dum. prisca* was produced. Secondly, either simultaneously or subsequently, a quicker mode of coiling must have been adopted; while thirdly, either simultaneously or subsequently—it is impossible to say which without examining the inner whorls of *Dum. prisca*, a small carina must have been produced, while the ribs must have become obsolete on the ventral area.

Such are the changes necessary to produce *Dum. prisca* from *Catull. Vernosæ;* and therefore *Dum. prisca* is a more developed form than *Catull. Dumortieri;* but the evolution of either may be said to be analogous to the production of *Caloceras* from forms possessing the Planicostan abdomen.[1]

Dum. prisca, *Dum. costula*, *Dum. sparsicosta*, and *Dum. Levesquei* may all be said to be analogous to *Caloceras;* and the inner whorls of the other species of *Dumortieria* show their connection with these forms. These other species, however, assume, when adult, a totally different appearance—the effect, solely, of continued lateral compression of the whorl; but this causes a convergence between *Grammoceras* and *Dumortieria*. *Dum. striatulo-costata*, *radians*, *Moorei*, &c., all show this Grammoceratan-like-stage, and only differ from one another in that the more they are developed the earlier they assume this stage. Unlike *Grammoceras*, these species of *Dumortieria* have apparently taken on this stage without passing through what may be called the Arietan stage,[2] that is, a period of sulcate and carinate ventral area. The inner whorls of *Dum. striatulo-costata* (Pl. XL) seem to indicate this fact clearly.

It is very curious that, while the smooth ancestral form splits up into two branches, one of which at the commencement of the Liassic period developed into *Caloceras* (*Ophioceras*), the other should have waited until the commencement of the Middle Lias, and should then have started on a career of similar changes. But the resemblance is even more peculiar than this. While *Caloceras* evolved the *Arietidæ*, first by producing a carina on its ventral area, and then by gradually broadening its ventral area—adding a furrow on each side of the carina,—the same thing should happen in certain species of the later *Catulloceras*- and *Dumortieria*-branches. But so it is. *Catulloceras Vernosæ* has an uncarinate ventral area, *Dum. prisca* and *Dum. Levesquei* add a small carina, while *Dum. arata* and *Catulloceras Dumortieri* have developed small furrows each side of the carina in the same manner as obtains in the *Arietidæ*. Still more curious than this, how-

[1] "The crossing of the abdomen by the pilæ . . . is common in the young of Caloceran forms" (Hyatt, "Genesis of the Arietidæ," 'Smithsonian Contributions to Knowledge,' vol. xxvi, p. 142). It may therefore be concluded that the abdomen crossed by pilæ, which Hyatt has previously tersely called "the Planicostan abdomen," was a feature of the *adult* ancestors of *Caloceras*.

[2] In *Grammoceras* the Arietan-stage may be said to be obsolescent; in *Dum. arata* and *Catull. Dumortieri* are signs of nascent Arietan-like characters.

ever, is the fact that in *Catulloceras scissum* the ventral area is a sunken furrow which the ribs do not cross; and this feature had appeared long previously in *Schlotheimia angulata*—a species which can only be traced to a much older branch of the stem which produced *Caloceras* and the *Arietidæ*.[1]

The manner in which Haug has derived the genus *Dumortieria*[2] differs in one particular from what I have stated, namely, that he interposes *Am. Jamesoni*[3] between *Polymorphites polymorphus* and *Catulloceras Vernosæ*. That *Pol. polymorphus* gave birth to *Pol. Bronni* and *Pol. confusus*—species with a carina, and with knobs on the outer end of their ribs—which in turn gave birth to *Am. Jamesoni*, I can readily imagine, but not that *Dumortieria* or *Catulloceras* is derived from *Am. Jamesoni*, because, as I have before remarked (pp. 161, 162), I cannot see the reason for the alteration of the complicated sutures of the adult *Am. Jamesoni* (Haug, *op. cit.*, p. 125) to the simpler sutures of *Am. Levesquei*. Haug also says that the chief difference between *Dum. Vernosæ* and *Am. Jamesoni* is that the former is much more strongly evolute. Both these facts are inversions of the usual process, which is a constantly increasing involution accompanied by a gradual progress in complexity of the sutures.

The similarity which exists between *Dumortieria* and *Am. Jamesoni* I very readily admit; but I account for this similarity by the fact that both are derived from a common ancestor. In effect, Haug's derivation of *Dumortieria* is more complicated than mine; because he makes out that the ancestral line has passed through two more stages, namely, the *Pol.-Bronni*-stage, and then, what is practically a reversion, the *Am.-Jamesoni*-stage, before it evolved the true *Dumortieria*. In my opinion *Dumortieria* came more directly from *Polymorphites polymorphus*, or perhaps from *Pol. peregrinus*; and the changes necessary to evolve it consisted only in the gradual production of coarser and coarser ribs (*Dum. Vernosæ*), and in time also a keel (*Dum. prisca* and *Levesquei*).

Such, then, are my views concerning the descent of *Dumortieria*; with which the genus *Catulloceras* may, for the present, be bracketed. I consider it preferable to treat of all the different species of these two genera in detail, and then in a postscript to add a few notes upon their evolution from one another.

The extraordinary convergence between certain species of *Dumortieria* and *Grammoceras*—a convergence which culminates in the two deceptively similar species *Dum. Moorei* and *Gramm. mactra*—renders it very necessary that the descent of *Dumortieria* and *Grammoceras* should be clearly traced. Taking only

[1] Hyatt, "Evolution of Arietidæ," 'Proc. Boston Nat. Hist. Soc.,' vol. xvi, fig. 73, p. 166, footnote; also "Genetic Relations of the Angulatidæ," ibid., 1874, p. 16; also "Genesis of Arietidæ," 'Smithsonian Contributions to Knowledge,' vol. xxvi, 1889.

[2] Haug, "Polymorphidæ," 'Neues Jahrbuch für Mineralogie, &c.,' 1887, Bd. ii, p. 120.

[3] Haug includes *Am. Jamesoni* in the genus *Dumortieria*, but I omit it.

Chief among the literature dealing with *Dumortieria* and its ally *Catulloceras* I must mention Haug's excellent work, "Ueber die *Polymorphidæ*, eine neue Ammonitenfamilie aus dem Lias," 'Neues Jahrbuch für Mineralogie, &c.,' Beil.-Bd. ii, 1887. Commencing with the Lower Lias, it treats of *Agassiceras* and different branches which have sprung therefrom (including *Dumortieria*) in a very complete manner. Its two plates contain figures of certain new species of the genus; and numerous tracings of suture-lines are given in the text. Another work to be consulted is Branco's 'Untere Dogger;' but see p. 169.

DUMORTIERIA PRISCA,[1] *S. Buckman*. Plate XXXVII, figs. 9—11.

Discoidal, evolute, carinate. Whorls almost circular, ornamented with coarse, distant, irregularly placed, direct ribs, which become smaller and closer-set on the last. Ventral area not defined, convex, divided by a very small carina, which is met almost at right angles by extremely obscure ribs. No inner margin. Inclusion about one-third or less. Umbilicus open, with gibbous-sided whorls ornamented with coarse, unequal-sized, unequally placed, distant ribs. Suture-line with a well-marked superior lateral lobe, and a markedly dependent inner portion.

The form, the ornamentation, and the sutures of this species are extremely suggestive of *Caloceras* (*Ophioceras*), especially of such a species as *Cal. liassicum*. These characteristics indicate that this is a little-developed form—that, in fact, this species from the *Jurense*-zone has only attained the same stage of development as these species of *Caloceras* at the base of the Lower Lias. The development of the ancestors of this species must have been greatly retarded; and it is not a little singular that when they did develop they should so copy the Lower-Liassic derivations from the ancestral stock (*Caloceras*). It is on account of this likeness to an ancient form that I have given this species the name of "*priscus*," old-fashioned.

Of course this species is the ancestor of *Dum. Levesquei*. Its outer whorl, where the ribs become smaller and closer-set, comparatively, and which has a slightly less circular section than its predecessors, foreshadows the features which are peculiar to *Dum. Levesquei;* and just in the same manner the outer whorls of *Dum. Levesquei* foreshadow the features which are peculiar and much more developed in *Dum. striatulocostata, Dum. pseudoradiosa*, or *Dum. radians*.

I believe that this species is undescribed. It is most interesting as supplying a link in the genealogy of *Dum. Levesquei;* and it indicates whence are derived those coarse irregular ribs to be seen in the innermost whorls of all species of *Dumortieria*, unless obliterated by the encroachment of senility.

[1] "*Priscus*" = old-fashioned.

The only species which at all approach this are *Dum. sparsicosta*, Haug, and *Dum. costula* (Reinecke). Both of them are doubtless its direct descendants. The former differs in having considerably more compressed, broader, and more ventrally-sharpened whorls, greater inclusion, and fewer turns in the umbilicus; while the latter differs very much in the same features, but has a more gibbous ventral area than *sparsicosta*.

The specimen figured is the only example known to me. It was collected by Mr. Darell Stephens, F.G.S., &c., and, as is the case with his specimens, its locality is accurately recorded. The label says, "The Sands, Hendford Hill, Yeovil;" and its horizon, therefore, is the lower part of the Yeovil Sands—in other words, the *Dumortieria*-beds (*Jurense*-zone).

Pl. XXXVII, figs. 9, 10, give two views of this specimen, and fig. 11 illustrates the characteristic suture-line.

DUMORTIERIA COSTULA (*Reinecke*). Plate XXXVII, figs. 12—15.

1818. NAUTILUS COSTULA, *Reinecke*. Maris protogæi, figs. 33, 34.
1846. AMMONITES RADIANS COSTULA, *Quenstedt*. Ceph., pl. vii, fig. 11.
1858. — AALENSIS COSTULA, *Quenstedt*. Der Jura, pl. xl, fig. 11.
1884. HARPOCERAS MUNIERI, *Haug*. Nouv. Amm.; Bull. Soc. géol. France, 3e série, t. xii, pl. xiii, fig. 3.
1885. — — — Beitr. Monogr. Harpoceras; Neues Jahrbuch für Mineral., &c., Beil.-Bd. iii, p. 663.
1885. AMMONITES STRIATULO-COSTATUS, *Quenstedt*. Amm. Schwäbischen Jura, pl. lii, fig. 8 only.
1885. — COSTULA, *Quenstedt*. Ibid., pl. liv, figs. 10—14 only.
1885. — FALCOFILA-SPARSICOSTA, *Quenstedt*. Ibid., pl. liv, fig. 35 only.
1887. DUMORTIERIA MUNIERI, *Haug*. "Polymorphidæ," Neues Jahrbuch für Mineralogie, &c., Bd. ii, p. 132.

Non *Am. costula*, Dumortier, Branco, Bayle, Vacek, &c. (see next page).

Discoidal, compressed, carinate. Whorls elliptical in shape, with gibbous sides, ornamented with distant, but not very prominent, unequally-spaced, direct, ventrally-inclined ribs. Between the ribs are indications of faint radii upon the core; but on the test are very fine striæ. Ventral area undefined, very slightly carinate. No inner margin. Inclusion about one-third.

The small specimen figured seems to me to agree with Reinecke's somewhat dubious figure better than anything else I possess. The larger specimen appears to differ from the smaller only in being somewhat less carinate; and possibly its whorl at the same size is a little more gibbous. This larger specimen, however,

agrees exactly with Quenstedt's delineation of *Am. radians costula*,[1] which was his interpretation of Reinecke's figure. Haug[2] appears to have had two or three species mixed as *Harp. costula*; for, while he recognised Quenstedt's figure as the young, he considered Dumortier's figure (see below) as the adult, and he also quoted Branco's figure as a synonym. Besides this, he had just previously (see synonyms) figured a specimen which to my mind agrees exactly with Quenstedt's *Am. radians costula*, and had called it *Harp. Munieri*. In a letter recently received from my friend he admits the agreement between *Munieri* and *Am. radians costula*, and observes "that if Quenstedt's specimen be really identical with Reinecke's species the name '*Munieri*' must fall into the synonymy." It seems to me that this is what must happen at present. If, however, the smaller specimen figured—which is Reinecke's *costula*—should prove not to be the young of the larger specimen—which is certainly Dr. Haug's "*Munieri*,"—then the latter name may stand.

Very different are the species which have been identified with Reinecke's *Am. costula*. As the chief of them I may notice the following:

1849. Am. radians costula, *Quenstedt*. Ceph., pl. vii, fig. 11.
1858. — aalensis costula, *Quenstedt*. Der Jura, pl. xl, fig. 11 (the same as above).
1874. — costula, *Dumortier*. (See *Hudlestonia Sinon*, p. 227.)
1878. Ludwigia costula, *Bayle*. Explic. carte géol. France, pl. lxxix, fig. 5; a *Grammoceras* closely allied to *Gramm. aalense*.
1879. Harpoceras costula, *Branco*. See *Gramm. costulatum*, p. 197.
1884. — — *Wright*. Lias Amm., pl. lxxxii, fig. 5. Fig. 6 is perhaps *G. distans*, p. 196.
1885. Ammonites costula, *Quenstedt*. Amm. Schwäbischen Jura, pl. liv, figs. 7—9 and 49, see *Gramm. costulatum*, p. 197; figs. 10—14 probably belong to this species; fig 50, see *Dum. subundulata*.
1886. Harpoceras costula, *Vacek*. Ool. Cap San Vigilio; Abh. k. k. geol. Reichsanstalt, Bd. xii, No. 3. The young of this species are very similar to Bayle's *costula*, but the adult form seems to indicate that the species belongs to *Harpoceras, sensu stricto*.

The small specimen figured is not unlike *Gramm. distans* (Pl. XXXIII, figs. 1, 2; see p. 196), but differs by its more gibbous whorls, its more distant, more direct ribs less ventrally-projected. These are just the points in which it agrees with Reinecke's *Am. costula*.

[1] 'Ceph.,' pl. vii.

[2] "*Harpoceras*," 'Neues Jahrbuch für Mineral., &c.,' 1885, Beil.-Bd. iii, p. 664.

From *Dum. Levesquei* this species differs in having rather more gibbous whorls and a smaller umbilicus. Its more distant and more irregular ribs, and the fine growth-lines on the test, are also distinctions.

It seems to me that this species is descended directly from *Dum. prisca*, from which it differs in having fewer whorls of a more elliptical shape, and a different arrangement of ribbing. Haug says, however, that "in the upper part of the *Jurense*-zone of Swabia all the intermediate forms between the typical *Dum. Levesquei* and *Dum. Munieri* are found together."[1]

The horizon of this species is, according to the above remarks, in the *Jurense*-zone; and the little specimen came from the division *Dumortieria*-beds of Cam Down, Gloucestershire. The larger specimen I purchased from the Wright Collection. Its locality is not recorded, but judging from its matrix I infer that it came from Yorkshire—probably from Blue Wyke, and from the beds known as the "*Striatulus*-shales."

The species is rare, and, generally, poorly preserved. The Long and Penn Woods, near Stroud, and Stinchcombe Hill, have yielded examples in addition to those figured.

Pl. XXXVII, figs. 12, 13, give two views of a small specimen from Cam Down, Gloucestershire, which I consider to agree with Reinecke's figure of "*Nautilus costula*." Figs. 14, 15, furnish two views of what is presumably a larger example of the same; and this agrees exactly with Haug's "*Harpoceras Munieri*." It probably came from Blue Wyke, Yorkshire.

DUMORTIERIA SPARSICOSTA, *Haug*. Plate XLV, figs. 17—20.

1885. HARPOCERAS (DUMORTIERIA) COSTULA, *Haug*. Beitr. Monogr. Harpoceras; Neues Jahrbuch für Mineralogie, &c., Beil.-Bd. iii, p. 664, *pars* (*teste* Haug).

1885. AMMONITES FALCOFILA SPARSICOSTA, *Quenstedt*. Amm. Schwäbischen Jura, pl. liv, fig. 29 (?).

1887. DUMORTIERIA SPARSICOSTA, *Haug*. "Polymorphidæ," Neues Jahrbuch für Mineral., &c., Bd. ii, p. 131, pl. v, fig. 3, and woodcut, fig. 6 *b*.

Discoidal, compressed, carinate. Whorls with convex sides, ornamented with subdirect, irregularly distant, rather inconspicuous ribs, which disappear on the outer third. Ventral area hardly defined, with a small carina. Inner margin fairly defined, steep, flattish. Inclusion about two-fifths. Umbilicus deeper in

[1] Haug, 'Polymorphidæ,' p. 132.

the centre than outside, ornamented with coarse, rounded, unequal-sized, irregularly distant ribs. Suture-line with rather short superior lateral lobe.

Only one specimen is known to me, but it agrees exactly with Haug's delineations except in the matter of the suture-line. This is not quite characteristic of the genus; it has shorter lobes and a less dependent inner portion than in Haug's drawing, and therefore appears more like the suture-line of a *Grammoceras*. These discrepancies, however, may possibly be explained by the fact that the sutures visible on my specimen are the last three; and, as they exhibit a decided reduction—the last being simpler than the penultimate, and this again than the antepenultimate, it is possible to infer that perhaps at half a whorl further back the suture-line would agree with Haug's delineation, which shows a characteristic *Dumortieria*-lobe-line.

Another point about this species which makes it resemble *Grammoceras* is the slight bending of the ribbing on the lateral area. It lacks, however, the strong forward ventral bend of *Grammoceras*. The ribs, it is true, disappear on the outer area, but their direction may be seen by following the fine growth-lines visible on the crystalline test.

Analogy, too, points strongly to the fact that my specimen is a *Dumortieria*, and is correctly identified, therefore, with Haug's species. Its inner whorls (diameter about 12 lines) conform so exactly in appearance with *Dumortieria prisca* (reaching 21 lines)—the same coarse irregular ribs are seen in the inner whorls of both species, only that they are not continued so long a time in *Dum. sparsicosta*.

A generally greater compression, and a sharper, more carinate ventral area, easily distinguish *Dum. sparsicosta* from *Dum. prisca*, its ancestor; while an umbilicus slightly more slowly-coiled, a whorl less gibbous ventrally, and numerous differences of ribbing distinguish it from its "cousin," *Dum. costula*. The characters of its ribs separate it completely from *Dum. Levesquei*.

Under the name "*falcofila sparsicosta*" Quenstedt figured two species in his 'Schwäb. Amm.' One (fig. 35) is *Dum. costula;* the other (fig. 29) is a small specimen, and might be the young of several species of *Dumortieria*, as, for instance, of *Dum. prisca*, *Dum. costula*, *Dum. Levesquei*, *Dum. striatulo-costata*, or this species. Haug having given a good figure and description of the present species under the present name, I consider *Dum. sparsicosta* to be founded on his authority, and that Quenstedt's figures may be left out of account altogether.

Only one specimen of this easily recognisable species have I had the good fortune to meet with. It came from the *Moorei*-beds (*Opalinum*-zone) of Buckholt Wood, and, for a Cotteswold specimen, is in very good preservation.

Pl. XLV, figs. 17, 18, exhibit two views of the above-mentioned specimen. Fig. 19 illustrates the aperture, and fig. 20 shows the penultimate and antepenultimate suture-lines from the same fossil.

DUMORTIERIA LEVESQUEI (*d'Orbigny*). Plate XXXVII, figs. 6—8; Plate XLV, figs. 15, 16.

1824. AMMONITES UNDULATUS, *Stahl* (non *Smith*). Correspbl. württemberg. landw. Ver., Bd. vi, p. 49, fig. 10 (?).[1]
1830. — — *Zieten*. Verstein. Württ., pl. x, fig. 5.
1830. — SOLARIS, *Zieten* (non *Phillips*[2]). Ibid., pl. xiv, fig. 7.
1842. — LEVESQUEI, *d'Orb.* Ceph. jurass.; Pal. Franç., pl. lx, p. 230 (inscribed on the plate as *Am. solaris*, Phillips).
1853. — — *Chapuis et Dewalque*. Foss. Luxembourg; Mém. cour. et Mém. des sav. étrang., tom. xxv, pl. xi, fig. 2.
1874. — UNDULATUS, *Dumortier*. Bass. Rhône, iv, p. 65.
1885. HARPOCERAS LEVESQUEI, *Haug*. Beitr. Monogr. Harpoceras; Neues Jahrbuch für Mineral., &c., p. 662.
1885. AMMONITES FALCOFILA, *Quenstedt*. Amm. Schwäb. Jura, pl. liv, figs. 28, 30, 31.
1885. — cf. UNDULATUS, *Quenstedt*. Ibid., pl. liv, fig. 27. (A form transitional to *Dum. pseudoradiosa*.)
1887. DUMORTIERIA LEVESQUEI, *Haug*. "Polymorphidæ;" Neues Jahrbuch für Mineral., &c., Bd. ii, p. 129.

Discoidal, slightly compressed, carinate. Whorls ornamented with somewhat distant, direct, ventrally-inclined ribs. Ventral area somewhat flattened, divided by a small rounded carina. Inner margin not defined, convex. Inclusion, about one-third. Suture-line with long siphonal and superior lateral lobes, causing a deep siphonal saddle.

As this is the typical species of the genus, I much regret that I have not been able to obtain any better material for figuring. The fragment, depicted Pl. XLV, figs. 15, 16, agrees exactly with d'Orbigny's representation, except that its ribs are a little closer.

The complete specimen, figured Pl. XXXVII, figs. 6—8, differs from d'Orbigny's in certain respects; but it agrees exactly with Zieten's delineation of *Am. solaris* (non Phillips). It is a more advanced form than d'Orbigny's—its ribs are closer together, and have a more forward inclination—its whorls are

[1] I am indebted to Dr. Haug's "Polymorphidæ" for this reference, which I have not been able to verify (see p. 242).

[2] *Am. solaris*, Phillips, 'Geol. Yorks,' 1st ed., pl. iv, fig. 29, has all the appearance of *Pleuroceras spinatum*.

thinner, and yet have more convex sides—its outer area is more pinched, making the ventral area narrower, and the carina more prominent—its inner margin is certainly less marked, and, as a consequence, its umbilicus is much flatter and less graduated—the suture-line has a somewhat differently-shaped, and shorter superior lateral lobe.[1]

This form almost deserves a separate name. It is to a certain extent transitional to *Dum. radians*, especially to the form figured Pl. XLII, figs. 11, 12. If the various figures be arranged in the following order they will, in a great measure, show all the stages of progression from *Dum. Levesquei* to *Dum. Moorei* —that is, from a gibbous, coarse-ribbed, evolute whorl to a compressed, fine-ribbed, rather involute whorl :—Pl. XLV, figs. 15, 16; Pl. XXXVII, figs. 6, 7; Pl. XLII, figs. 11, 12; Pl. XLII, figs. 6, 7; Pl. XLIV, figs. 7, 8. This series is exactly parallel to the series *Gramm. toarcense*, *Gramm. striatulum*, *Gramm. mactra*.

I quite agree with Dr. Haug when he remarks that d'Orbigny's name "*Levesquei*" is better known, and not likely to lead to mistakes, as would be the case with the name "*undulatus*." The latter name was first used by Smith, in 1817, for *Ammonites falcifer*, Sowerby;[2] and, in 1824, Stahl[3] applied it to an Ammonite doubtfully identified with the present species.[4] I make the above remarks upon the authority of Dr. Haug (see foot-notes), because all my efforts to procure Stahl's work have failed.

The Ammonite which Zieten figured as "*undulatus*" is probably this species; but the figure is very poor. Dumortier undoubtedly referred to this species by the name "*undulatus*."

This species is very scarce, and I have only been able to obtain inferior fragments from Long Wood and Buckholt Wood near Stroud, and from Wotton-under-Edge, Gloucestershire. Mr. Darell Stephens, F.G.S., procured the species from the vicinity of Yeovil Junction.

The type form is illustrated by a poor fragment depicted in Pl. XLV, figs. 15, 16; and the variety, about which I have remarked above, is shown in Pl. XXXVII, figs. 6—8.

[1] Dr. Haug tells me that this form is identical with the examples found in the Rhône-basin.

[2] Haug, "Harpoceras;" 'Neues Jahrbuch für Mineralogie, &c.,' Beil.-Bd. iii, p. 662, 1885.

[3] 'Correspbl. württemb. landw. Ver.,' Bd. vi, p. 49, fig. 10.

[4] Haug, "Polymorphidæ," 'Neues Jahrbuch,' Bd. ii, p. 130, 1887.

so curiously alike; and when the gibbous inner whorls are covered by the flattened outer whorls the whole appearance of the species is changed.

The adult specimen, Pl. XL, figs. 1, 2, illustrates this matter exactly. Apparently it differs but little from *Grammoceras doerntense* (Pl. XXIX, figs. 1, 2) or from *Gramm. aalense* (Pl. XXXII, figs. 1, 2); but its young (Pl. XL, figs. 3—6) differs very appreciably from the young of either *Gramm. doerntense* (Pl. XXIX, figs. 6, 7) or *Gramm. aalense* (Pl. XXXII, fig. 3).

Dumortieria striatulo-costata is evidently a further development of *Dum. Levesquei*. Practically speaking, its inner whorls (Pl. XL, figs. 3, 4) are *Dum. Levesquei* in miniature; and it is not until it has passed a diameter of 10 lines that the specific characters peculiar to *D. striatulo-costata* are developed.

Under the name *striatulo-costatus*, Quenstedt combined a series of four species, as Dr. Haug has already noticed.[1] For Quenstedt's fig. 7 alone Haug retained the name "*striatulo-costatus*;" but he reserved it as a variety of Branco's "*subundulatus*." I agree with Dr. Haug as to the form to which the name *striatulo-costatus* shall be applied, though I extend its range somewhat to include certain others, and give it specific rank; but for certain reasons (see article on *Dum. subundulata*) I reserve Branco's name "*subundulata*" for his pl. iii, fig. 4.

Of the present species there are several varieties illustrating a gradual change of form due to development in the normal manner. First there is Quenstedt's wide-centred form, which retains the ancestral—the *Levesquei*—stage to a late period of growth. Of this I have only poor examples, not good enough to figure. Next there is the form figured by Branco (his pl. iii, fig. 3 only) and by Haug ("Polymorphidæ," pl. v, fig. 4), each of which has a smaller centre than Quenstedt's. I have not a specimen sufficiently good for delineation; but they only differ from those I have had depicted (Pl. XL, figs. 1—9) and from Haug's figures of *subundulatum* ('Nouv. Amm.,' pl. xiii, fig. 2) in not being so much pinched ventrally. I doubt if it be worth while to distinguish between these two forms. I fancy they may be united as var. α; while var. β differs in being much more compressed, and in losing the *Levesquei*-stage at a very much earlier age. Var. β is illustrated by two slightly different forms—one a south-country specimen, Pl. XXXVII, figs. 16, 17; the other a Cotteswold specimen, Pl. XL, figs. 10—12.

Taken altogether, the whole series indicates gradual development from the evolute ancestor *Dum. Levesquei* to the more involute, compressed *Dum. striatulo-costata*, var. β, and this series is parallel to the *Levesquei-Moorei* series (p. 242).

To return to the species figured by Quenstedt under the name "*striatulo-costatus*." His fig. 7, as I have said, may be taken as the type of the present species; fig. 8 is *Dum. costula* (p. 237); to the form depicted in fig. 9 Haug has given the

[1] "Polymorphidæ," 'Neues Jahrbuch für Mineralogie, &c.,' Bd. ii, p. 135, 1887.

name *Dum. suevica*;[1] and fig. 10 is *Dum. Moorei*. *Dum. suevica*, which apparently differs from *Dum. radians* in nothing except the absence of a carina on the ventral area, is the only one of these species which I am unable to record in this Monograph.

Dumortieria striatulo-costata is a rather scarce species; and very rarely is it found in anything like good condition. The type and var. *α* are characteristic of the *Dumortieria*-beds (*Jurense*-zone) of the Cotteswolds; while var. *β* belongs to the *Moorei*-beds (*Opalinum*-zone), both in the Cotteswolds and in the south. Of the type-form I have a few very inferior specimens from Buckholt Wood and the Long Wood near Stroud, and from Wotton-under-Edge. Of var. *α* I possess better specimens, which came from Penn Wood; and of var. *β* I have fair specimens from the *Moorei*-beds (*Opalinum*-zone) of the same locality, and from the same horizon (Yeovil Sands) of Stoford (Yeovil Junction), Somerset.

Pl. XL, figs. 1, 2, show two views of a fine adult specimen of this species (var. *α*) from Penn Wood, near Stroud. Figs. 3, 4, are inner whorls, to be compared with *Dum. prisca*, to which they bear great resemblance; figs. 5, 6, are the same with about half a whorl added, and they may be compared with *Dum. Levesquei*; while figs. 7, 8, illustrate the completed specimen, showing the assumption of Grammoceratan-like characters. Fig. 9 is the suture-line taken from another specimen.

Pl. XXXVII, figs. 16, 17, illustrate two views of a specimen of var. *β* from the Dorset-Somerset district; while Pl. XL, figs. 10, 11, give two views of a somewhat finer-ribbed Cotteswold specimen, of which fig. 12 is the suture-line.

DUMORTIERIA, sp. Plate XXXVII, figs. 18, 19.

This specimen bears considerable resemblance to the specimen of *Dum. striatulo-costata* depicted on the same plate; but its ribs are more distant, its whorls are more compressed, and its umbilicus, which is very flat, is a trifle larger. The specimen is only in poor preservation, so that I cannot say much; but it seems to be distinct from any of the species of the genus. It was collected by Mr. Darell Stephens, F.G.S., and is labelled "Yeovil Junction." Presumably it came from the shell-beds of the Yeovil Sands, *Moorei*-beds (*Opalinum*-zone).

Pl. XXXVII, figs. 18, 19, give two views of this specimen.

[1] "Polymorphidæ," p. 139; see also *Dum. exigua*, p. 252.

PSEUDORADIOSA (*Branco*). Plate XLI, figs. 1—3, 9, 10.

1879. HARPOCERAS PSEUDORADIOSUM, *Branco*. Unt. Dogger; Abh. geol. Spez.-Karte Elsass-Lothringen, Bd. ii, pl. ii, fig. 1 only.

1881. AMMONITES MOOREI, *J. Buckman*. Terminations Inf. Ool. Amm.; Quart. Journ. Geol. Soc., vol. xxxvii, p. 65, fig. 7.

1885. — UNDULATUS, *Quenstedt*. Amm. Schwäbischen Jura, pl. liv, fig. 26.

1887. DUMORTIERIA PSEUDORADIOSA, *Haug*. "Polymorphidæ;" Neues Jahrbuch für Mineral., &c., Bd. ii, p. 141.

Discoidal, compressed, carinate. Whorls with sides somewhat flattened, ornamented with well-marked, somewhat distant, direct, ventrally-inclined ribs. Ventral area rather broad, fairly defined, ornamented by a small, distinct carina. Inner margin smooth, convex, fairly defined. Inclusion about one-third. Umbilicus deep in the centre, but more open and flat towards the outside. Termination a plain sigmoidal bend, with a rounded ventral process.

Branco observed that Dumortier's figures of *Am. radiosus* did not agree with Seebach's; and he consequently figured three specimens under the name "*H. pseudoradiosum*," quoting Dumortier's figures as synonyms. I cannot, however, allow that Branco's specimens agree with Dumortier's figures; for, excepting fig. 3, they have fewer and broader whorls, greater inclusion, and coarser ribs. Neither do Branco's specimens seem to agree with one another. The specimen depicted in figs. 2, 2*a*, is not only finer ribbed, but has a smaller umbilicus than fig. 1. The specimen shown in fig. 3 certainly agrees more nearly with Dumortier's figure in side view, and yet it agrees rather better with certain fine-ribbed forms of *Dum. subundulata*. As no front view is given this point must remain uncertain, but unfortunately no front view of this specimen is given, and so I cannot be perfectly certain whether my identification be correct.

It is necessary to restrict Branco's name "*pseudoradiosum*" to his figure. The ribs of *Dum. pseudoradiosa* vary in their size and distance apart. Sometimes they are large and distant, then they are small and approximate, and finally they are coarser and distant again. Branco noticed this fact (p. 77), and mens both show a fine-ribbed period, though it is a very short one, su a coarser-ribbed period. This character, however, is of little specific is not confined to this species. As now defined, *Dumortieria pseudo* is very greatly from *Dum. radians*, especially from the [illegible] [illegible]fer [illegible]249). It is, however, of much coarser build altog [illegible]hicker. Judging from the very depre

border complete; fig. 3 exhibits the ventral area of the end of the last whorl, showing the fine striæ crossing a degraded carina. Figs. 9, 10, show two views of a fragment of a young example.

DUMORTIERIA RADIANS (*Reinecke*). Plate XLI, figs. 4—8; Plate XLII, figs. 1—12; Plate XLIII, figs. 1—4. Woodcut in text, p. 187, fig. 2.

1818. NAUTILUS RADIANS, *Reinecke*. Maris protogæi Nautilos, &c., figs. 39, 40.
1846. AMMONITES RADIANS DEPRESSUS, *Quenstedt*. Ceph., pl. vii, figs. 5, 6 only.
1858. — — *Quenstedt*. Jura, pl. xl, fig. 9.
— AALENSIS, *Quenstedt*. Ibid., pl. xl, fig. 12.
1874. — RADIOSUS, *Dumortier* (non *Seebach*). Études Pal. Bassin Rhône, iv, pl. xiv, figs. 2—5.
1879. HARPOCERAS SUBCOMPTUM, *Branco*. Unt. Dogger; Abh. geol. Spez.-Karte Elsass-Lothringen, Bd. ii, pl. v, fig. 3 only (see p. 198).
1885. AMMONITES, cf. AALENSIS, *Quenstedt*. Amm. Schwäbischen Jura, pl. liv, fig. 18 only.
1885. — cf. COMPTUS, *Quenstedt*. Ibid., pl. liv, fig. 46.
1885. — RADIANS, *Quenstedt*. Ibid., pl. liv, fig. 44.
1887. DUMORTIERIA RHODANICA, *Haug*. "Polymorphidæ;" Neues Jahrbuch für Mineral., &c., Bd. ii, p. 138.

Discoid, compressed, carinate. Whorls elliptical, the sides convex, and ornamented with direct, ventrally-inclined, sharply-marked ribs. Ventral area acute, not always defined, divided by a small, distinct carina. Inner margin convex, not defined. Inclusion from one-third to one-half.

Reinecke's figure of "*Nautilus radians*" certainly leaves much to be desired, and it is evidently not altogether exact. The carina is certainly too prominent; while the sectional view does not agree with the length of the aperture as shown in the side view, for it is much too short. It is impossible to determine whether this is a mistake of the artist, or whether the sectional view was taken from elsewhere on the shell; but when measured by compasses this section will be found to agree with the breadth of the whorl at the bottom of Reinecke's fig. 39 (see p. 187).

In spite, however, of its mistakes, Reinecke's figure can, as I pointed out at pp. 186, 187, be recognised not only as a *Dumortieria* on account of its ribbing, but as illustrating the specimens which I have figured under that name; and this view of the interpretation of Reinecke's figure is just the one taken by Quenstedt, only that he included as "*radians*" several other forms which have nothing to do with the present species.[1]

[1] For a synopsis of species to which the name "*radians*" has been applied see pp. 188 *et seq.*

identified, and which must be excluded as belonging not only to different species, but to different genera. The synonyms given at the heading of this article will further supplement this list by indicating which species described under other names must be united under the name "*radians*."

Under the name *Am. radiosus* Dumortier (*loc. cit.*) gave figures of two specimens, one of which (figs. 3, 4) is practically identical with Reinecke's figure of *Am. radians*. The only difference observable is that the aperture of fig. 4 is longer and more compressed. Most of my specimens show the same difference; but the value of this difference is diminished when it is remembered that *Dum. radians* was, like the other species of the genus, gradually assuming a more and more elliptical whorl. The elliptical whorl, therefore, is merely a sign of progress; and, further, much depends on where the section of the whorl is taken. How great a difference half a whorl may make in this matter is amply illustrated by Pl. XLII, figs. 2, 14.

Branco[1] recognised that Dumortier's *Am. radiosus* was not the same as Seebach's, and he bestowed the name "*H. pseudoradiosum*" on fossils of which he gave a figure, while he quoted Dumortier's figures in the synonymy; but Branco's figures do not agree with Dumortier's (see p. 246).

Haug also recognised that Dumortier's figures did not represent Seebach's *Am. radiosus*;[2] and he consequently bestowed a new name, "*rhodanica*." This name must now fall as one of the synonyms of "*radians*."

According to my interpretation *Dumortieria radians* is very variable; the size and distance of the ribs, the amount of inclusion of whorl, and the compression of the whorl giving rise to great variety of form. As the immediate progenitor of this species—say *Dum. Levesquei*—possessed widely-separated ribs, therefore such ribs are to be found in the inner whorls of *Dum. radians*. In fig. 1, and in fig. 8, Pl. XLII, it may be seen that they are superseded at an early date by the finer and closer ribbing—the ribbing of "*radians*." Fig. 11 of the same plate is again a rather abnormal form, wherein the coarse ribs are continued to the end, but only after a period of finer ribbing.

The compression of the whorl varies considerably, as may be seen by comparing Pl. XLII, figs. 7 and 10; and the shape of the whorl varies very much in the same specimen. The more developed the specimen the more compressed is the whorl; and figs. 3 and 6 show that the compressed specimens not only have finer ribbing, but have superseded the coarse ribbing—the ancestral character—at so early an age as to almost obliterate it.

That *Dumortieria radians* is descended from *Dumortieria Levesquei* there can be little doubt; and Dr. Haug says that intermediate forms bind the two species

[1] "Untere Dogger;" 'Abh. z. geol. Spez.-Karte von Elsass-Lothringen,' Bd. ii, p. 77, 1879.

[2] "Ueber Polymorphidæ;" 'Neues Jahrbuch für Mineral., &c.,' Bd. ii, p. 138, 1887.

The woodcut, fig. 2 in the text (p. 187), is a copy of Reinecke's original figures given for comparison with the examples depicted in the Plates.

DUMORTIERIA RADIANS, *var.* EXIGUA, *S. Buckman.* Plate XLIII, figs. 11—13; Plate XLIV, figs. 1—3.

1830. AMMONITES STRIATULUS, *Zieten* (non *Sowerby*). Verstein. Württ., pl. xiv, fig. 6.

1885. — cf. RADIANS, *Quenstedt.* Amm. Schwäbischen Jura, pl. liv, fig. 19.

Zieten's figure represents this form exactly, except that it is a little thicker in the aperture than my examples. These fossils differ from *Dum. radians* in combining a more compressed form with a rather large umbilicus and very slight inclusion of the whorls. The size of the umbilicus separates them particularly from the specimen depicted, Pl. XLII, figs. 6, 7, which resembles them in being much compressed.

The larger umbilicus and the coarser radii separate this form from *Dum. Moorei.*

Dr. Haug tells me that these specimens have great resemblance to his *Dum. rhodanica* (see p. 250), but are a trifle thinner. This, I think, is just the point which is noticeable; but they also have finer ribs. Dr. Haug recognises figs. 6—12, Pl. XLII, as *rhodanica;* but the specimens there depicted I have admitted as *radians*, and this variety differs from them in the manner just noticed.

Haug ("Polymorphidæ," p. 139) cited the reference to Zieten as a synonym of his *Dum. suevica*, only he expresses some doubt in the matter. *Dum. suevica* is, according to Haug, a keelless form, and is very much thicker, judging from Quenstedt's figs. 9, 10, pl. lii ('Schwäb. Amm.'), upon which Haug has founded his species; and it is therefore essentially different from the present form.

Dumortieria radians, var. *exigua*, is a scarce fossil. I have obtained it at Penn Wood, and Buckholt Wood, near Stroud, and at Sodbury, Gloucestershire. Pl. XLIII, figs. 11, 12, represent a specimen from Penn Wood; and fig. 13 is a suture-line from another specimen.[1] Pl. XLIV, figs. 1, 2, show a larger example from the same place; while fig. 3 is the suture-line of this specimen.

[1] The specimen from which this suture-line was traced has been mislaid, so that I do not know the reason for the discrepancy between this and fig. 3, Pl. XLIV.

ibbing; fig. 15 is the suture-line. Pl. XLIII, figs. 5, 6, give a larger example h similar features; fig. 7 is the suture-line.

UMORTIERIA RADIOSA, *var.* GUNDERSHOFENSIS, *Haug*. Plate XXX, fig. 18; Plate XLV, figs. 13, 14.

1830. AMMONITES LINEATUS, *Zieten* (non *Schlotheim*). Verstein. Württ., pl. ix, fig. 7.

1879. HARPOCERAS PSEUDORADIOSUM, *Branco*. Unt. Dogger; Abh. z. geol. Spez.-Karte v. Elsass-Lothringen, Bd. ii, pl. ii, figs. 2, 2 *a* only.

1884. — AALENSE, *Wright* (non *Zieten*). Monogr. Lias Amm.; Pal. Soc., vol. xxxviii, pl. lxxxii, figs. 1, 2 only.

1887. DUMORTIERIA RADIOSA, var. GUNDERSHOFENSIS, *Haug*. Polymorphidæ; Neues Jahrbuch für Mineral., &c., Bd. ii, p. 140, pl. iv, fig. 7.

Discoidal, compressed, carinate. Whorls broad, ornamented with subdirect, ventrally-inclined radii. Ventral area sloping, fairly defined, ornamented with a small, distinct carina traversed by fine growth-lines. Inner margin convex, slightly defined, scored by the ends of the radii. Inclusion about two-fifths.

Dr. Haug remarks that the typical form of *Dum. radiosa* has fine[1] ribs in youth, and in old age extremely fine, closely-set growth-lines; but the variety *gundershofensis* has in youth what may be called either large growth-lines or fine ribs, and in old age blunt, distant ribs. The point, however, is that the variety *gundershofensis* is ornamented just the reverse to what obtains in the type, or among other species of *Dumortieria*. Instead of having coarse ribs becoming finer, it has fine ribs becoming coarser.

I fancy that the variety *gundershofensis* deserves to rank as a separate species much more than *Dum. radiosa*; and I do not feel at all sure that it is a variety of that form. I should be more inclined to consider it a mutation of "*radians*." However, my material of *radiosa* and its variety being scanty, I leave the matter as Dr. Haug placed it.

The specimen, Pl. XXX, fig. 18, exactly bears out Dr. Haug's remarks concerning the ornamentation; but the larger example has coarse ribs, at first, for some time, then a period of half-a-whorl of fine ribs, and then commences the more distant ribs. This specimen is thinner than Haug's outline-figure 7 *c*, which however, does not appear to me to correspond to his fig. 7 *b*, because the whorl are represented too narrow (from back to front) and too thick. The specimen agrees in all respects with 7 *a*, *b*.

[1] My specimens have coarse ribs.

Moorei. It struck me that the words "My Collection," which occur in the explanation of Plate LXXX, figs. 1—3, in the 'Monograph of the Lias Ammonites,' might have been written by accident. In answer to my inquiries, Mr. E. T. Newton, F.G.S., of the Museum of Practical Geology, wrote that "we have always been under the impression that the specimen VI-$\frac{3}{48}$, figured by Dr. Lycett, was refigured by Dr. Wright; but on comparing the specimen with the figures I find that, although the agreement in size and character is exact, there are points about the mouth which differ." Mr. G. C. Crick, F.G.S., of the British Museum, informs me that no specimen answering to Dr. Wright's figures was met with in the collection of the type specimens of "the Lias Ammonites" which the British Museum obtained from a dealer after that gentleman's death. Such is the evidence obtainable; but it is only right to remark that, as the whole of Dr. Wright's Collection was not acquired by the British Museum, it is possible the figured specimen may have been lost sight of. In any case, for all practical purposes, Dr. Wright's figures may be considered as a representation of Dr. Lycett's original specimen; and this is an important matter, for the figure of the latter author is so much reduced as to be misleading. Dr. Wright's figures agree exactly in size with Dr. Lycett's specimen, but differ in the following trivial points, viz. that the lower ventral area is too acute, the mouth a trifle too compressed at top, and the ribs of the inner whorls not coarse enough.

I have the following notes made from an examination of Lycett's original specimen:—"In the inner whorls the ribs are coarse and somewhat wide apart, while the whorls themselves are slightly gibbous. The outer whorls are nearly flat, and the radii become much finer until on the end of the body-chamber they are merely very fine growth-lines. The radii are very little curved on the lateral area, and not much curved forwards on the ventral area. (Lycett's description differs from this, but he probably had specimens of *Dum. Moorei* and *Gramm. mactra* mixed together: his figure is correct.) The carina is little more than a sharpening of the ventral area. It is continued on to the body-chamber."

It was in 1857 that Lycett named this species *Am. Moorei*, in compliment to Charles Moore, F.G.S.; but the same name was used by Oppel ('Juraformation,' p. 476) in the same year. I do not know which species has priority; but it makes no difference now, as Oppel's species belongs to the genus *Perisphinctes*.

In 1874, however, Dumortier recognising the difficulty, and considering that Lycett's *Am. Moorei* and what he figured as *Am. mactra* (see p. 176) were identical, superseded the name *Am. Moorei* by that of *Am. mactra* ('Bassin Rhône,' iv, p. 252).

In 1879 Branco gave an excellent figure of *Am. Moorei* under the name *Harpoceras mactra*, and he quoted Lycett's figure as a synonym.

In 1884 Wright figured *Am. Moorei* under the name *Harp. aalense* (Zieten). In 1885 Haug placed *Am. Moorei*, Lycett, as a synonym of *Am. mactra*, Dumortier,

PLATE XXXVII.

Jurense-zone.

Figs. 1—5.—POLYPLECTUS DISCOIDES (*Zieten*).

Fig. 1.—Suture-line of a specimen from White Lackington, Somerset, to show the accessory tuft to the siphonal lobe, the forceps-like ending (*f*) to the superior lateral lobe, and the accessory lobe (*a a*) to the siphonal saddle nearly equal in size to the inferior lateral lobe—the last detail being different from d'Orbigny's delineation. The suture is of natural size, and is copied from a drawing of mine. (Page 219.)

Fig. 2.—Side view of a small specimen from Milhau, Aveyron, France. (Page 215.)

Fig. 3.—Front view of the same specimen to show the view of the chamber-wall with its lobes and saddles, demonstrating the existence of a well-marked accessory lobe (*a a*) in the siphonal saddle, a point omitted in d'Orbigny's and Wright's figures.

Fig. 4.—The terminal branch (much enlarged) of the siphonal lobe when the side of the whorl is $3\frac{1}{2}$ lines broad.

Fig. 5.—The same when the side is $5\frac{3}{4}$ lines broad. The letters *a*—*e* indicate the same points in each figure, and show their development.

Figs. 6—8.—DUMORTIERIA LEVESQUEI (*d'Orbigny*).

Fig. 6.—Side view of a well-preserved, but not quite typical specimen. From the Yeovil Sands, Yeovil Junction (? Stoford, Somerset). Collected by Mr. Darell Stephens, F.G.S. (see Pl. XLV). (Page 241.)

Fig. 7.—Front view of the same specimen.

Fig. 8.—Suture-line of the same specimen, showing the deep siphonal and inferior lateral saddles, and the dependent inner portion,—characteristic features of the lobe-line of this genus.

Figs. 9—11.—DUMORTIERIA PRISCA, *S. Buckman.*

Fig. 9.—Side view of a fairly well-preserved specimen. Yeovil Sands, Hendford Hill, Yeovil, Somerset. Collected by Mr. Darell Stephens, F.G.S. (Page 236.)

Fig. 10.—Front view of the same, showing the almost circular aperture and the very small carina.

Fig. 11.—Suture-line from the same specimen.

Figs. 12—15.—DUMORTIERIA COSTULA (*Reinecke*).

Fig. 12.—Side view of a small example comparable to Reinecke's figure. Cam Down. My Collection. (Page 237.)

Fig. 13.—Front view of the same.

Fig. 14.—Side view of a larger specimen without test, except a piece at the top showing fine lines. This is exactly the *Dumortieria Munieri*, Haug. I purchased it out of the Collection which belonged to the late Dr. Wright. The locality is unrecorded, but the black stony matrix suggests the "*Striatulus*-shales" of Blue Wyke, Yorkshire.

Fig. 15.—Front view of the same.

Opalinum-zone (Moorei-beds).

Figs. 16, 17.—DUMORTIERIA STRIATULO-COSTATA (*Quenstedt*), var. β.

Fig. 16.—Side view of an example with complete test. Shell-beds of the Yeovil Sands, Stoford, Somerset (labelled Yeovil Junction). Collected by Mr. Darell Stephens, F.G.S. (Page 243.)

Fig. 17.—Front view of the same.

Figs. 18, 19.—DUMORTIERIA, sp.

Fig. 18.—Side view of a rather poorly-preserved specimen. Shell-beds of the Yeovil Sands, Stoford, Somerset (labelled Yeovil Junction). Collected by Mr. Darell Stephens, F.G.S., &c. (Page 245.)

Fig. 19.—Front view of the same.

PLATE XXXVI.

Fig. 2.

Fig 1

Fig 4

Fig 5.

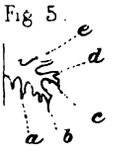

Fig 3.

Fig. 9.

Fig 12

Fig 13.

Fig 11.

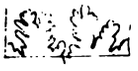

Fig 18

Fig 14.

Fig 15.

Fig 10

Fig.19.

Fig. 8

Fig 17

Fig 7.

Fig. 6

Fig.16.

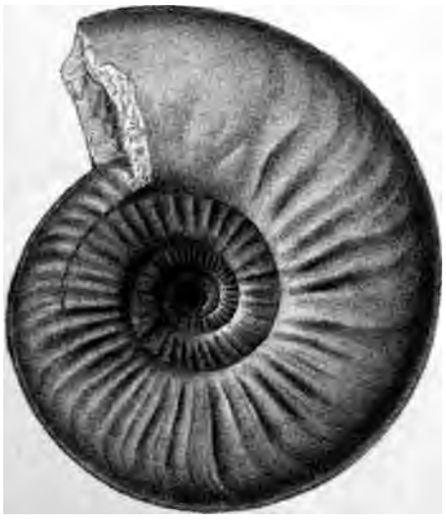

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PLATE XXXVIII.

Jurense-zone (Dumortieria-beds).

Figs. 1—8.—HUDLESTONIA AFFINIS (*Seebach*).

Fig. 1.—This figure, from the end to about the top part of fig. 4, is an outline taken from a large, very rough fragment. (The circumference beyond this point, and the centre-lines have been filled in to convey an idea of the complete Ammonite.) Penn Wood, near Stroud. My Collection. (Page 228.)

Fig. 2.—Outline of the aperture of the large end.

Fig. 3.—Outline at the small end. On account of the wretched preservation of the specimen these outlines are only approximately exact, especially ventrally.

Fig. 4.—Side view of a fragment, showing the smooth outer whorl, and the ribbed inner whorls attached to it, but apparently not in correct position. This fragment has been so placed on the plate to give an idea of the whorl of fig. 1. "The Yellow and Grey Sands below Dogger, Blue Wyke," Yorkshire. In the Collection of Mr. W. H. Hudleston, F.R.S., &c.

Fig. 5.—Front view of the inner whorls of fig. 4.

Fig. 6.—Aperture of the outer whorl of fig. 4.

Fig. 7.—Side view of another specimen. "Grey Sands, Blue Wyke," Yorkshire. In the Collection of Mr. W. H. Hudleston, F.R.S.

Fig. 8.—Back view of the same. (Figs. 7 and 8 have been restored by the artist to the best of his ability at my desire, so as to give an idea of the specimen as it should be. The original is distorted, broken, and poorly preserved.)

Figs. 9—12.—HUDLESTONIA SERRODENS (*Quenstedt*).

Fig. 9.—Outline of the side view of a poorly-preserved specimen. Penn Wood, near Stroud. My Collection. (Page 229.)

Fig. 10.—Aperture of the same.

Fig. 11.—Aperture of another specimen. Cam Down, near Dursley. My Collection.

Fig. 12.—Suture-line of the same.

Figs. 13—16.—HUDLESTONIA SINON (*Bayle*).

Fig. 13.—Side view of a fragmentary and poorly-preserved example. "Grey Sands, Blue Wyke," Yorkshire. In the Collection of Mr. W. H. Hudleston, F.R.S. (Page 227.)

Fig. 14.—Portion of ventral area of the same.

Fig. 15.—Aperture of the same as nearly as it can be determined.

Fig. 16.—Suture-line of the same.

PLATE XXXIX.

Zone uncertain (*Jurense ?*).

Figs. 1—2 *a*.—DUMORTIERIA ARATA, *S. Buckman*, var.

Fig. 1.—Side view of a variety with greater portion of test, but it is rather ill-preserved. The locality is not recorded; but presumably the specimen came from the Marly Limestone which underlies the Yeovil Sands, Trent, Somerset. Collected by my father.

Fig. 2.—Front view of the same, showing the furrows beside the carina.

Fig. 2 *a*.—Suture-line of the same specimen.

Jurense-zone (Dumortieria-beds).

Figs. 3—5.—DUMORTIERIA ARATA, *S. Buckman*.

Fig. 3.—Side view of a fragmentary specimen which lacks the test. Penn Wood, near Stroud. My Collection.

Fig. 4.—Back view of the same specimen.

Fig. 5.—Suture-line of the same specimen.

Figs. 6—9.—CATULLOCERAS DUMORTIERI (*Thiollière*).

Fig. 6.—Side view of a specimen without much test, and not well preserved. The occasional deeper furrows separating the ribs (periodic constrictions) are to be noticed. Found in a fallen block of calcareous sandstone (Yeovil Sands) on the beach at Burton Bradstock by Mr. J. E. Clark, F.G.S., who very kindly presented it to me on the spot.

Fig. 7.—Front view of the same specimen.

Fig. 8.—Ventral portion of the same specimen towards the end of the whorl, to show the ribs ending short of the carina, thus producing a faint furrow, and also to exhibit the influence of a constriction.

Fig. 9.—Suture-line of the same specimen.

Figs. 10, 11.—CATULLOCERAS LEESBERGI (*Branco*).

Fig. 10.—Side view of a very poorly-preserved example. Wotton-under-Edge. My Collection.

Fig. 11.—Front view of the same.

Figs. 12—14.—CATULLOCERAS INSIGNI-SIMILIS (*Brauns*).

Fig. 12.—Side view of a fragment. Stinchcombe Hill, Gloucestershire. My Collection.

Fig. 13.—Back view of the same.

Fig. 14.—Aperture of the same.

PLATE XL.

Jurense-zone (Dumortieria-beds).

Figs. 1—9.—DUMORTIERIA STRIATULO-COSTATA (*Quenstedt*), var. α.

Fig. 1.—Side view of a fine adult example. Penn Wood, near Stroud. My Collection. (Page 243.)

Fig. 2.—Front view of the same specimen.

Fig. 3.—Side view of the inner whorls broken out of the specimen depicted in Fig. 7.

Fig. 4.—Front view of the same, to show the almost uncarinate ventral area, and nearly circular whorls. Compare with *Dum. prisca*, Pl. XXXVII, fig. 10.

Fig. 5.—Side view of the same specimen with an additional half-whorl.

Fig. 6.—Front view of the same, showing elliptical aperture. Compare with *Dum. Levesquei*, Pl. XXXVII, fig. 7.

Fig. 7.—Side view of the same example complete. Penn Wood, near Stroud. My Collection.

Fig. 8.—Aperture of the same.

Fig. 9.—Suture-line from another specimen.

Opalinum-zone (Moorei-beds).

Figs. 10—12.—DUMORTIERIA STRIATULO-COSTATA (*Quenstedt*), var. β.

Fig. 10.—Side view, showing the greater inclusion. Penn Wood. My Collection (see Pl. XXXVII, fig. 16). (Page 243.)

Fig. 11.—Front view of the same.

Fig. 12.—Suture-line of the same.

Fig 3

Fig. 4

Fig. 2.

Fig. 7

Fig 5

Fig 6.

Fig.8.

Fig 9.

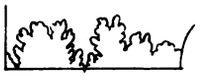


Fig. 12.

Fig 1

Fig. 11

Fig. 10.

PLATE XLI.

Jurense-zone.

Figs. 1—3.—Dumortieria pseudoradiosa (*Branco*).

Fig. 1.—Side view of a very fine adult specimen, with the mouth-border and most of the test preserved. It was collected by Mr. T. C. Maggs, F.G.S., from the Yeovil Sands, Yeovil Junction; and its mouth was figured in the 'Quart. Journ. Geol. Soc.,' vol. xxxvii. It is now in my cabinet. (Page 246.)

Fig. 2.—Front view of the same specimen.

Fig. 3.—The ventral area of the end of the whorl with part of the mouth.

Figs. 4—8.—Dumortieria radians (*Reinecke*).

Fig. 4.—Side view of a fairly-preserved example. Yeovil Sands, Bradford Abbas. Collected by my father. (Page 248.)

Fig. 5.—Front view of the same.

Fig. 6.—Suture-line of the same.

Fig. 7.—Side view of an example to compare with Reinecke's figure. Locality unrecorded; probably Yeovil Sands, Bradford Abbas. Collected by my father.

Fig. 8.—Front view of the same.

Figs. 9, 10.—Dumortieria pseudoradiosa (*Branco*).

Fig. 9.—Side view of a fragment. Yeovil Sands, Bradford Abbas, Dorset. My Collection. (Page 246.)

Fig. 10.—View of the ventral area of the same, comparable with figs. 5 and 8, to show greater thickness.

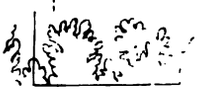


PLATE XLII.

Jurense-zone (Dumortieria-beds).

Figs. 1—12.—DUMORTIERIA RADIANS (*Reinecke*).

Fig. 1.—Side view of a specimen, to compare with Reinecke's figure. Penn Wood, near Stroud. My Collection. (Page 248.)

Fig. 2.—Front view of the same.

Fig. 3.—Side view of a fine-ribbed variety without test. Penn Wood. My Collection.

Fig. 4.—Front view of the same.

Fig. 5.—Suture-line of the same.

Fig. 6.—Side view of a compressed variety. Cam Down, near Dursley, Gloucestershire. My Collection.

Fig. 7.—Front view of the same.

Fig. 8.—Side view of a thick variety. Cam Down. My Collection.

Fig. 9.—Back view of the same.

Fig. 10.—Aperture of the same.

Fig. 11.—Side view of a variety with distant ribs. Cam Down. My Collection.

Fig. 12.—Front view of the same.

Figs. 13—15.—DUMORTIERIA RADIOSA (*Seebach*).

Fig. 13.—Side view of a form showing inner whorls comparable to *Dum. prisca* or *Dum. Levesquei*, and outer whorl with fine ribbing. Cam Down. My Collection. (Page 253.)

Fig. 14.—Front view of the same, showing the variation in the shape of the whorls at different times.

Fig. 15.—Suture-line of the same specimen.

Fig. 1.

Fig. 2.

Fig. 14.

Fig. 12

Fig. 5

Fig. 15.

Fig. 3.

Fig. 4.

Fig. 10

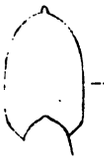


Fig. 9.

Fig. 8.

Fig. 11

Fig. 12.

Fig. 7.

Fig. 6.

PLATE XLIII.

Jurense-zone (Dumortieria-beds).

Figs. 1—4.—DUMORTIERIA RADIANS (*Reinecke*).

Fig. 1.—Inner whorls, natural size. Fig. 1 *a*, side view enlarged three times, showing the commencement of the ribbing; 1 *b*, front view, showing the smooth, rounded ventral area and circular aperture; 1 *c*, suture-line. (Page 251.)

Fig. 2.—Inner whorls (fig. 1 with a piece added), natural size. Fig. 2 *a*, side view enlarged three times; 2 *b*, front view; 2 *c*, suture-line.

Fig. 3.—Inner whorls with additional pieces, natural size. Fig. 3 *a*, side view, enlarged twice, showing finer ribbing; 3 *b*, front view, showing more compressed whorls with commencement of carina.

Figs. 4 *a*, *b*.—Side and front views of the complete specimen, by breaking up of which the specimens for figs. 1, 2, 3, were obtained. Cam Down. My Collection.

Opalinum-zone (Moorei-beds).

Figs. 5—7.—DUMORTIERIA RADIOSA (*Seebach*).

Fig. 5.—Side view of a large specimen showing coarse ribs in the inner whorls, which whorls are somewhat tumid. Penn Wood. My Collection. (Page 253.)

Fig. 6.—Outline of the front view.

Fig. 7.—Suture-line of the same specimen.

Opalinum-zone (Moorei-beds).

Figs. 8—10.—DUMORTIERIA SUBUNDULATA (*Branco*), var.

Fig. 8.—Side view of a fine example with greater portion of test preserved. Shelly beds of the Yeovil Sands, Stoford, Somerset (Yeovil Junction). From my father's Collection. (For other examples see Pl. XLV.)

Fig. 9.—Front view of the same specimen.

Fig. 10.—Suture-line of the same specimen.

Figs. 11—13.—DUMORTIERIA RADIANS, var. EXIGUA (*S. Buckman*).

Fig. 11.—Side view of a specimen with test. Penn Wood. My Collection. (Page 252.)

Fig. 12.—Front view in outline.

Fig. 13.—Suture-line from another specimen.

PLATE XL.

Fig 1 1a 1b.

x3.

Fig. 1c.

Fig. 2. 2a 2b

x3.

Fig. 2c

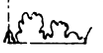
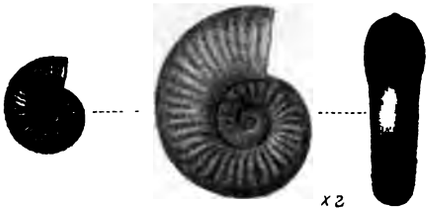


Fig. 3. 3a 3b

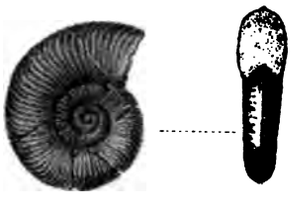


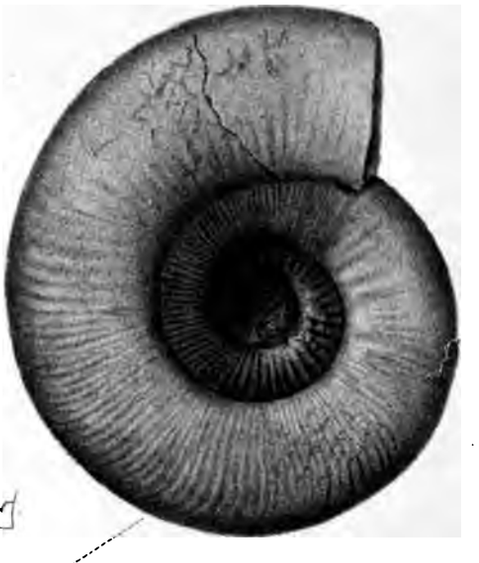
x2

Fig. 3.

Fig. 11.

Fig. 4a Fig. 4b.





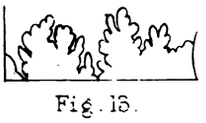


Fig. 13.

Fig. 12.

Fig. 7

Fig. 10.

Fig. 8

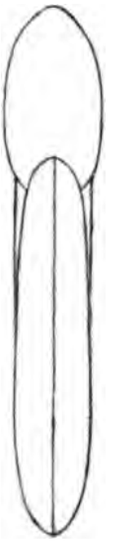


Fig. 6

Fig. 9.

PLATE XLIV.

Dumortieria- or Moorei-beds.

Figs. 1—3.—Dumortieria radians, var. exigua, *S. Buckman.*

Fig. 1.—Side view of a specimen without test. Penn Wood. My Collection. (Page 252.)

Fig. 2.—Front view of the same.

Fig. 3.—Suture-line of the same.

Opalinum-zone (Moorei-beds).

Figs. 4—9.—Dumortieria Moorei (*Lycett*).

Fig. 4.—Side view of a specimen with very fine striæ. Little of the very thin test remains, but the test shows the fine striæ, while the core has faint ribs. From the shell-beds of the Yeovil Sands, Stoford, Somerset. My Collection. (Page 255.)

Fig. 5.—Front view of the same.

Fig. 6.—Suture-line of the same specimen.

Fig. 7.—Side view of a more involute form with the mouth-border. Buckholt Wood. My Collection.

Fig. 8.—Front view of the same.

Fig. 9.—Suture-lines taken from Lycett's original specimen, now preserved in the Museum of Practical Geology.

Figs. 10—12.—Dumortieria subundulata (*Branco*), var.

Fig. 10.—Side view of a rather involute form with the test and the mouth-border; but the lateral lappet is incomplete. Frocester Hill (Coaley Peak). My Collection.

Fig. 11.—View of ventral area, showing the short ventral process and the angle at which the ribs cross the carina, indicating that the specimen is a *Dumortieria.*

Fig. 12.—Suture-line of the same specimen.

Fig. 10.

Fig. 11.

Fig 12

Fig. 4

Fig. 2.

Fig. 3.

Fig. 5.

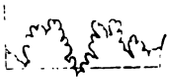


Fig. 6.

Fig. 8.

Fig. 7

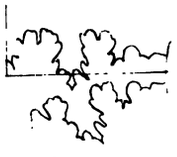


Fig. 9

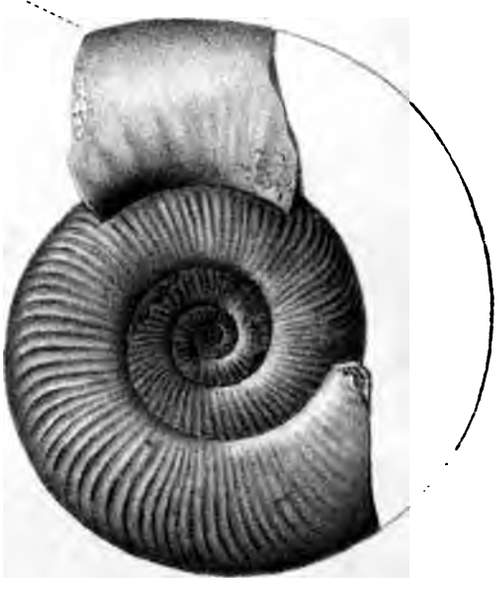


Fig. 1

THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

VOLUME FOR 1890.

LONDON:
MDCCCXCI.

A MONOGRAPH

OF THE

DEVONIAN FAUNA

OF THE

SOUTH OF ENGLAND.

BY

G. F. WHIDBORNE, M.A., F.G.S.

PART III.

THE FAUNA OF THE LIMESTONES

OF

LUMMATON, WOLBOROUGH, CHIRCOMBE BRIDGE, AND CHUDLEIGH.

PAGES 155—250; PLATES XVI—XXIV.

LONDON:

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

1891.

PRINTED BY
ADLARD AND SON, BARTHOLOMEW CLOSE.

Lower Dunscombe, near Chudleigh, whose fossils correspond with those of Adolf and Oberscheld, and which should therefore be placed at the base of the Upper Devonian and immediately below the Saltern-Cove series. From this place Prof. Römer[1] records *Goniatites intumescens*, *G. multilobatus*, Beyr. (= *G. sagittarius*, Sandb.), and *Orthoceras acuarium*, Münst. ?; and Dr. Kayser[2] adds to these *Goniatites acutus*, Münst., and *G. simplex*, von Buch.

Dr. Holl,[3] in his paper on Devonshire, enumerates twenty-four South Petherwyn species, viz. *Orthoceras cinctum*, Sow., *O. laterale*, Phill., *O. striatum*, Sow., *O. ludense*, Sow., *O. striatulum*, Sow., *O. Phillipsii*, d'Orb., *Poterioceras fusiforme*, Sow. ?, *Cyrtoceras rusticum*, Phill., *Goniatites bifer*, Phill., *G. vinctus*, Sow. (= *G. insignis*, Phill.), *G. linearis*, Münst., *G. subsulcatus*, Bronn, *Nautilus megasipho*, Phill., and eleven *Clymeniæ*.

In the first volume of his 'British Museum Catalogue' Foord describes ten *Orthocerata*, one *Actinoceras*, and two *Cyrtocerata* from Devonshire, though in many cases the poorness of the specimens prevented him from giving them specific names. Three of these species, *Orthoceras laterale*, Phill. ?, *O. ? tentaculare*, Phill., and *O. Vennense*, Foord (= *O. cylindraceum*, Sow. and Phill., not Fleming), are from Mudstone Bay. He also doubtfully refers a specimen from Lower Dunscombe to *Actinoceras striatum*, Sow., sp.

The number of Devonian Cephalopods given in Etheridge's 'Catalogue,' excluding three repetitions, is fifty-seven.

[1] 1880, F. Römer, 'Geol. Mag.,' dec. 2, vol. vii, p. 145.
[2] 1889, Kayser, 'Neues Jahrbuch für Min.,' Band i, p. 179.
[3] 1868, Holl, 'Quart. Journ. Geol. Soc.,' vol. xxiv, p. 413.

CORRIGENDUM.

Pl. V, fig. 1. This large specimen belongs to Mr. Vicary, and not, as erroneously stated in the Explanation of the Plate, to the Torquay Museum.

Class.—GASTEROPODA, *Goldfuss*, 1820.

The Gasteropoda have yielded a much greater variety of species from the localities now under notice than have any other class of fossils. They are, however, very unequally represented in them. By far the largest number come from Wolborough, except in the case of one family, the Capulidæ, which is very abundant both individually and specifically at Lummaton. From Chircombe Bridge there are hardly any to record. The small group of species from Chudleigh, on the other hand, includes several shells which are of peculiar interest. These occur chiefly in the Keswell Quarry in a decomposed matrix which has allowed them to be extracted almost uninjured and entire. They are all very rare, with the exception of *Murchisonia turbinata*, Schlotheim, which has been obtained in very large numbers. This shell is remarkable for the amount of specific variation which it displays. The specimens of it are hardly ever exactly alike, and their great abundance permits us to range under the one species fossils which otherwise we should be obliged to regard as specifically or even generically distinct, and thus enables us to surmise that it is possible that, if we were equally fortunate in some other cases, we might be able to unite several forms which at present we are forced to consider as separate species.

The number of Univalves described by Phillips was 24, viz. 23 from Newton, 1 from Barton, and 1 from Chudleigh—one of which, however, he treated as a Cephalopod. Besides these, eight shells described by him from other places are found to have occurred in the present localities; but, on the other hand, I have been unable to meet with any examples of one or two of his Newton species, while two or three of the remainder must, as it seems to me, be removed from the list as synonyms.

The number of species is now raised to about 113, which are divided between the genera Pirhachis (1), Macrochilina (10), Loxonema (7), Michelia (1), Spanionema (1), Littorina (2), Naticopsis (1), Natica (3), Strophostylus (1), Platyostoma (3), Capulus (15), Orthonychia (2), Holopella (5), Scoliostoma (2), Antitrochus (1), Philoxene (3), Euomphalus (10), Phanerotinus (3), Plagiothyra (2), Rotellina (1), Lecanospira (1), Flemingia (1), Ehasmonema (1), Turbo (3), Pleurotomaria (19), Murchisonia (6), Oligotomaria (1), Bellerophon (5), Porcellia (1), Helminthochilus (1).

It is of course very often impossible to fix with any degree of certainty the biological position of these shells, for the mouth is generally obscured or defective; and the arrangement of the genera is rendered all the more difficult by the fact that under the best of circumstances the shell only gives indirect information of

the character of the animal, and that among the Gasteropoda there is so much similarity in the shells of many widely different organisms that it is very hard to settle by analogy the real position of any genus which is represented only by extinct species.

Order.—PULMONATA, *Ehr.*, 1831.

I. *Family.*—Auriculidæ, *Blainville.*

1. *Genus.*—Dirhachis,[1] *gen. nov.*

Shell elongate, elevated, spiral. Whorls convex, ornamented with spiral ridges reticulated by oblique threads. Mouth small, widely ovoid, with continuous lips. Inner lip bearing two large folds or teeth, which appear to be continued within the shell. Outer lip smooth, bevelled, and slightly crenulated within the margin. Shell-structure massive.

This genus is formed for a single species, which, as pointed out to me by Mr. E. A. Smith, very nearly approaches *Plectotrema*. It differs from it in having a smooth outer lip, and only two teeth on the inner lip, as well as in some other particulars.

1. Dirhachis atavus, n. sp. Pl. XXV, fig. 15.

Description.—Shell small, elevated, conical, spiral. Spire large, rather slowly increasing, of three or more convex, very broad, much-exposed volutions. Suture rather wide and deep, irregular. Whorls regularly and flatly convex, bearing seven or eight sharp elevated spiral ridges, divided by broad shallow grooves, crenulated by more numerous transverse, regular, close threads or growth-lines. Body-whorl small; in section sloping rather convexly from the suture to the lower part (which is the widest) and there curving round rapidly to form an oblique base; ornamented by eleven ridges similar to those in the upper whorls, but broken into tubercles by thicker and coarser growth-lines; the ridge next the suture being the most prominent, and those on the lower part being smaller and closer, and gradually vanishing on the base. No umbilicus. Mouth small, elongate, pyriform, pointed above, rounded below. Outer lip dilate, moderately convex, sharp. Peristome slightly

[1] From δίς, twice, and ῥάχις, a spine or ridge.

crenulated within. Inner lip straight, continuous, thickened, elevated, bearing on the side of the aperture two distinct rounded teeth, which seem to be continued as ridges within the shell. Shell-structure massive.

Size.—Height 13 mm., width 10 mm.

Locality.—There is a single specimen from Chudleigh in the Woodwardian Museum.

Remarks.—This small shell is somewhat crushed, but otherwise it is in a beautiful state of preservation. I am not certain whether a shell which I have seen in Mr. Champernowne's collection belongs to the same species, but otherwise I know nothing else like it from the present localities. The dentition of the mouth is peculiar.

Affinities.—Externally it comes very near to *Turbo mutabilis*, F. A. Römer,[1] but it has more numerous spiral ridges and a much smaller apical angle, and is generically separated from it by the teeth of its inner lip.

From *Cyclonema Guillieri*, Œhlert, as given by Barrois,[2] it differs in the shape of its mouth, in its longer spire, smaller body-whorl, and strong longitudinal striæ.

Order.—PROSOBRANCHIA, *Milne Edwards*, 1848.

I. *Family.*—Pseudomelaniidæ, *Fischer*, 1887.

1. *Genus.*—Macrochilina, *Bayle*, 1880.

This genus comprises spirally ovoid or buccinoid shells, which are not umbilicated, and have a slightly twisted or folded columella. It is either smooth or longitudinally striated. Its mouth is ovoid, simple, and effuse below. It extends from the Devonian to the Trias.

It differs from *Loxonema* in its more ovoid shape, its fewer whorls, and its folded columella.

The genus was first established by Phillips in 1841 under the name *Macrocheilus;* but de Koninck[3] points out that that name had been previously applied by F. W. Hope in 1838 to a group of insects. Therefore, although Zittel and Fischer both retain Phillips's name, it appears necessary to follow de Koninck in employing the term *Macrochilina*, which was proposed for it by Bayle[4] at his suggestion.

[1] 1850, F. A. Römer, 'Beitr.,' pt. 1, p. 36, pl. v, fig. 21.

[2] 1889, Barrois, 'Faun. Calc. d'Ebray,' p. 220, pl. xv, figs. 12 *a*, *b*.

[3] 1881, de Koninck, 'Ann. Mus. Roy. H. N. Belg.,' vol. vi, pt. 3, p. 36.

[4] 1880, Bayle, 'Journ. de Conch.,' ser. 3, vol. xix, p. 35.

1. MACROCHILINA SUBCOSTATA, *Schlotheim*, sp. Pl. XVI, figs. 1—6.

1821.	BUCCINITES SUBCOSTATUS, *Schlotheim*.	Petrefakten-Kunde, p. 130, pl. xii, fig. 3.
1827.	BUCCINUM IMBRICATUM, *Sow.* (pars).	Min. Conch., vol. vi, p. 127, pl. dlxvi, fig. 2, right-hand figure only.
? 1840.	— — —	Geol. Trans., ser. 2, vol. v, pt. 3, pl. lvii, fig. 23 *a* only.
1841.	MACROCHEILUS ARCULATUS, *Phillips*.	Pal. Foss., p. 139, pl. lx, fig. 194.
1841.	— ELONGATUS, *Phillips*.	Ibid., p. 104, pl. xxxix, fig. 195.
? 1841.	— IMBRICATUS, *Phillips* (pars).	Ibid., p. 104, pl. xxxix, fig. 194 *a* only (not *Phil.* Geol. York).
1842.	— SCHLOTHEIMI, *d'Archiac* and *de Verneuil*.	Geol. Trans., ser. 2, vol. vi, pt. 2, p. 354, pl. xxxii, fig. 2.
1843.	LOXONEMA PHILLIPSI, *F. A. Römer*.	Verst. Harz., p. 30, pl. viii, fig. 9.
1843.	— ADPRESSUM, *F. A. Römer*.	Ibid., p. 30, pl. viii, fig. 10.
1844.	BUCCINUM ARCULATUM, *Goldf.* (pars).	Petref., vol. iii, p. 28, pl. clxxii, fig. 15 *b* only.
1849.	MACROCHEILUS SUBCOSTATUS, *d'Orbigny*.	Prodrome, p. 63.
1849.	PHASIANELLA ADPRESSA, *d'Orbigny*.	Ibid., p. 68.
1854.	MACROCHEILUS IMBRICATUS, *Morris* (pars).	Cat. Brit. Foss., p. 256.
1854.	— SUBCOSTATUS, *Morris*.	Ibid., p. 256.
1854.	— ELONGATUS, *Morris*.	Ibid., p. 256.
1884.	LOXONEMA PHILLIPSI, *Clarke*.	Neues Jahrb. f. Min., Beil.-Band iii, p. 364.
1887.	MACROCHEILUS SUBCOSTATUS, *Tschernyschew*.	Mém. Com. Géol. Russ., vol. iii, No. 3, p. 171, pl. v, figs. 6 *a*, *b*.
1888.	— ARCULATUS, *Etheridge*.	Foss. Brit., vol. i, Pal., p. 163.
1888.	— ELONGATUS, *Etheridge*.	Ibid., p. 163.
1888.	— SUBCOSTATUS, *Etheridge*.	Ibid., p. 164.
1889.	— — *Whidborne*.	Geol. Mag., dec. 3, vol. vi, p. 30.

Description.—Shell large, turriculated, fusiform; mucronate at the apex, more or less inflated about the body-whorl, somewhat contracted at the base. Spire consisting of about six or seven broad, slightly convex volutions. Suture shallow, facing outward. Aperture ovate, narrow, very contracted at the upper angle. Inner lip covered by a wide, flattened, spiral callosity, which is keeled above, and extends round the columella. Body-whorl occupying about two-thirds the height of the shell, flattened or slightly convex above, and becoming rather suddenly convex below. Shell-structure thin.

Surface of the body-whorl covered with numerous, strong, low, distant, transverse, overhanging, acute ridges, facing away from the mouth, starting perpendicularly downwards from the suture, and almost immediately arching backwards

for about one-sixth of their length, after which they again become perpendicular to the suture until near the base, when they again sweep rapidly backwards until they are merged in the fold of the inner lip. Minor ornamentation consisting of fine irregular striæ following the course of the larger markings. Surface of upper whorls with similar ridges, truncated halfway down by the suture-line of the succeeding whorl.

Size.—A specimen from Wolborough measures about 70 mm. in height and about 40 mm. in width.

Localities.—From Lummaton there are two well-preserved fragments in my Collection. From Wolborough there are five specimens in Mr. Vicary's Collection; five in the Museum of Practical Geology; five in the Torquay Museum; one in the Woodwardian Museum; and one in the British Museum. In the Torquay Museum is a small specimen from an unknown locality which is replaced by beekite.

Remarks.—This fine species does not appear to be uncommon. It is represented in museums, as seen above, by many fine specimens, which show most of its details, although they are rarely sufficiently perfect to give its exact dimensions. The outer lip is in every case defective or destroyed. They are often crushed or contorted, and this is probably due to the thinness of the shell-walls. These specimens appear to present some variability in the length of the spire and the number of the whorls, but their general facies is so similar that there can be little doubt that they all belong to one species.

Two of Phillips's figured specimens are among those in the Museum of Practical Geology. One of these is the type of his species *M. elongata*, and this at first sight appears to differ from the rest in being a more spindle-shaped shell with a much longer columella. These differences, however, are deceptive, being entirely due to the imperfection of the specimen. It has been longitudinally fractured, as indicated in his figure, and this fracture was caused by the shell having been subjected to lateral crushing, which has given the appearance of greater length to the shell and of greater obliquity of the suture-line, as well as bringing the inner lip into undue prominence. Moreover, the outer lip has been broken off straight down the perpendicular from the apex, so as to make it simulate a long siphuncle, whereas in all likelihood there was originally no elongation of the base at all. In fact, several of the other specimens, which are crushed, look on the one side exactly like this shell, while on the other side they agree exactly with Phillips's figure of his *M. arculata*, except that they are even broader. Hence it is clear that the species *M. elongata* cannot be retained, but must be reunited to the present form. It may be noted that Phillips's figure is rather larger than life-size.

The other figured specimen in the same Museum is Phillips's type of

his *M. arculata;* and this he describes as coming nearer to *M. arculata*, Schlotheim sp. (young state), than to any other shell he knew. This fossil perfectly agrees with the general run of our specimens, though it is much smaller than some of them, and is probably a young shell. It bears just below the suture a low and indistinct spiral thread. It cannot, however, be classed with the true *M. arculata* of Schlotheim. In company with Mr. T. Roberts I compared it with the figures of that shell given by Schlotheim,[1] by Goldfuss,[2] and by d'Archiac and de Verneuil,[3] and also with that of *M. acuta*, Sow. sp., in the 'Min. Conch.,' and we then came to the conclusion that it was distinct from any of them, except one of Goldfuss's figures which seems to differ from the rest. Moreover, a fine typical German specimen of *M. arculata* shows the same; its body-whorl is narrower, the ridges of its surface are much less defined, and it has the flat angulated shoulder of that species, of which there are no signs in these Devonshire fossils.

On the other hand, Schlotheim's figure of his other species, *M. subcostata*, fairly represents our specimens, and there is every reason to suppose that they belong to it. His figure is almost exactly like the Torquay Museum specimen (Pl. XVI, fig. 4) when viewed from a different aspect from that figured. It has its upper whorls more convex, and is a broader shell, than is usual in the English fossils. D'Archiac and de Verneuil figure this species under the name of *M. Schlotheimi*, and distinguish it from *M. arculata* by the absence of any flat horizontal area below the suture, and by other features. Their figure appears only to differ from our shells by having a shorter body-whorl and more obscure ornamentation, and they assert it to be the same as Schlotheim's *M subcostatus*. As they state the species to be very variable, and as the English fossils lie between Schlotheim's form and their own, we have here a confirmation of their identity. They change Schlotheim's name for reasons which are insufficient.

Loxonema Phillipsi, F. A. Römer,[4] seems from his description to be identical with our shell; and *Loxonema adpressum*, F. A. Römer,[5] though it appears to be much more elongate, is probably only a variety or contorted example of it.

Affinities.—Clarke[6] gives a better figure of the specimen figured by F. A. Römer[7] as *Loxonema imbricatum*, which shows that its ornament consists of fine imbrications, and therefore that it is not, as Goldfuss supposed, identical with the present species.

[1] 1820, Schlotheim, 'Petrefact.,' p. 128, pl. xiii, figs. 1 *a*, *b*.

[2] 1844, Goldfuss, 'Petref.,' vol. iii, p. 28, pl. clxxii, fig. 15 (exclude 15 *b*).

[3] 1842, d'Archiac and de Verneuil, 'Geol. Trans.,' ser. 2, vol. vi, pt. 2, p. 354, pl. xxxii, fig. 1.

[4] 1843, F. A. Römer, 'Harz.,' p. 30, pl. viii, fig. 9.

[5] 1843, ibid., p. 30, pl. viii, fig. 10.

[6] 1884, Clarke, 'Neues Jahrb. f. Min.,' Beil.-Band iii, p. 367, pl. v, figs. 19, 20.

[7] 1843, F. A. Römer, 'Harz.,' p. 30, pl. viii, fig. 11.

2. **Macrochilina arculata**, *Schlotheim*, sp. Pl. XVI, figs. 8, 8 *a*, 9, 9 *a*.

1820. **Buccinites arculatus**, *Schlotheim*. Petrefacten-Kunde, p. 128, pl. xiii, figs. 1 *a*, *b*.
1842. **Macrocheilus arculatus**, *d'Archiac* and *de Verneuil*. Geol. Trans., ser. 2, vol. vi, pt. 2, p. 354, pl. xxxii, fig. 1.
1844. **Buccinum arculatum**, var. **ventricosum**, **torosum**, and **carinatum**, *Goldfuss*. Petref., vol. iii, p. 29, pl. clxxii, figs. 15 *a*, *c*, *d*, and *e* (only).
1844. — **Oceani**, *Goldfuss*. Petref., vol. iii, p. 29, pl. clxxiii, fig. 1.
1849. **Macrocheilus Oceani**, *d'Orbigny*. Prodrome, p. 63.
1852. **Buccinum arculatum**, *Quenstedt*. Handb. Petref., p. 416, pl. xxxiii, fig. 17.
1876. **Macrocheilus arculatus**, *F. Römer*. Lethæa Pal., pl. xxxii, fig. 6.
1881. — — *Zittel*. Handb. Pal., pt. 1, Band ii, p. 239, fig. 320.

Description.—**Shell large,** turriculated, fusiform, mucronate at the apex, more **or less inflated about the body-whorl,** somewhat contracted at the base. Spire **consisting of about six or seven** broad, slightly convex volutions. Suture shallow, **facing upwards. Whorls** rising from the suture to form a small rounded or **flattened shoulder, and thence** proceeding downwards in a slightly convex curve. **Aperture ovate, narrow,** very contracted above. Inner lip covered by a wide **flattened callosity, which is** keeled above and extends round the columella. Body-whorl occupying about two-thirds the height of the shell, shouldered above, flattened or slightly convex in the upper parts, and becoming rather suddenly convex below. Shell-structure rather thin. Surface of body-whorl marked with very numerous, low, distant, unequal, longitudinal ridges, divided by shallow furrows, starting perpendicularly from the suture, then arching backwards, and then becoming again perpendicular, until near the base they again sweep rapidly backwards till they are merged in the fold of the inner lip; irregularly covered and partially obscured by more numerous finer ridges. Surface of upper whorls similar, but truncated halfway down by the succeeding whorls.

Size.—A specimen measures 70 mm. in height by 37 mm. in width.

Locality.—Chudleigh. There are several fine specimens in Mr. Vicary's Collection, and one in the British Museum.

Remarks.—This species is very similar to *M. subcostata*, which has frequently been confounded with it. D'Archiac and de Verneuil have, however, distinguished them, and a comparison of the English specimens with Schlotheim's figures of the two species leads me to think that the French authors are right in their conclusions. The Chudleigh fossils are generally shorter and stouter shells than

those from Wolborough, and their whorls are more or less shouldered or folded over at the top instead of proceeding in a straight convex curve down from the suture. This feature is, however, much obscured in them by the matrix, and is less prominent than it is in Schlotheim's type and in many other German shells. There also appears to me to be a constant difference in the ornament, that in the Chudleigh fossils being finer and more irregular than that in the other English shells. I therefore believe that they must be regarded as distinct, and as respectively belonging to Schlotheim's two species, which are both described as very variable.

Goldfuss has united these two species, dividing them, however, into several varieties, among which he figures shells which agree with each.

Buccinum Oceani, Goldfuss,[1] appears from the very poor specimen figured to be more elongate, and to have a higher spire and broader whorls. I am, however, inclined to think that these differences are due to contortion and to its being a cast, and that it probably belongs to the present shell.

3. Macrochilina lincta, *Phillips*, sp. Pl. XVI, fig. 10.

1841. Loxonema lincta, *Phillips*. Pal. Foss., p. 100, pl. xxxviii, figs. 185 *a*, *b*.
1854. — — *Morris*. Cat. Brit. Foss., p. 255.
1888. — — *Eth*. Foss. Brit., vol. i, Pal., p. 163.

Description.—Shell small, conical, of about five volutions. Suture linear, crenulated by the ornament. Whorls narrow, adpressed so as to form a fine hem or beading round the suture, otherwise moderately concave. Body-whorl about equal in height to the rest of the spire. Surface covered with fine and prominent, arched, longitudinal ridges, separated by similarly-shaped furrows, sloping backwards from the bead below the suture, becoming perpendicular over the central parts of the whorl, and then curving gently backwards again in the lower part of the body-whorl. Mouth not shown except in its upper part, which is wide and acute; apparently short.

Size.—Height of a specimen wanting the lower part of the mouth 15 mm., width 9 mm.

Locality.—Barton; a single specimen is in the Lee Collection in the British Museum.

Remarks.—The one specimen of this shell known to me is unfortunately imperfect at its base, so that only part of the body-whorl and of the mouth can be seen. I believe that it belongs to the species described by Phillips under the name of "*Loxonema lincta*," though in several particulars it is unlike his figure. Thus it

[1] 1844, Goldfuss, 'Petref.,' vol. iii, p. 29, pl. clxxiii, fig. 1.

is slightly more slender in shape, the whorls are rather flatter, the striæ are more oblique, and the edges of the whorls overlap the suture to a greater degree. Nevertheless the general aspect of the shell is very similar, and the enlarged pattern which Phillips gives exactly corresponds and shows the beading. Upon the whole, Mr. Lee's specimen is quite as much like Phillips's figure as are many of his other types to the figures which he gives of them; and as many of his originals from Barton were in Mr. Lee's Collection, I am strongly of opinion that the present fossil was the actual shell from which Phillips drew his figure and described this species. It is to be noted that there is every appearance of imperfection about the base of his figure, which is just the place where the present fossil is defective.

We may therefore, I think, take it for granted that the present species, as represented by the shell in the British Museum, is the *Loxonema lincta* of Phillips; and we have next to observe that Phillips, although placing it under the genus *Loxonema*, suggests that *Buccinum imbricatum*, Sow., and *B. arculatum*, Goldfuss, should be referred to the same genus as this shell: these latter he ultimately included in his new genus *Macrocheilus*, and it is evident that Mr. Lee's shell belongs to that genus. This gives another argument for its identity with Phillips's shell, as he speaks of "the disproportion of the whorls (owing to the last including and concealing so much of the penultimate);" and this feature, not seen in his figure, would remove one of the differences we have noted above.

Affinities.—From *M. subcostata*, Schloth., sp., the present shell is separated by its much larger spire and shorter body-whorl, and by the simpler character of its ornamentation. From the other accompanying species it is distinguished by not being smooth, and from most of them by the shortness of its body-whorl.

4. Macrochilina imbricata, *Sowerby*, sp. Pl. XVII, figs. 1—4.

1827. Buccinum imbricatum, *Sowerby*. Min. Conch., p. 127, pl. dlxvi, fig. 2 (left-hand figure only).
1840. — acutum, *Sowerby*. Geol. Trans., ser. 2, vol. v, pt. 3, pl. lvii, fig. 23 (not Min. Conch.), *fide* M'Coy.
1854. Macrocheilus imbricatus, *Morris* (pars). Cat. Brit. Foss., p. 256.
1855. Macrochilus ventricosus, *Sedgw.* and *M'Coy*. Brit. Pal. Foss., p. 399.
1857. Buccinum lævе, *Eichwald*. Bull. Soc. Nat., Moscow, p. 173 (young).
1860. Macrocheilus lævis, *Eichwald*. Lethæa Rossica, p. 1118, pl. xlii, figs. 7 *a*, *b* (young).
1888. — imbricatus, *Etheridge*. Foss. Brit., vol. i, Pal., p. 164.
1888. — ventricosus, *Etheridge*. Ibid., p. 164.

Description.—Shell large, smooth, conical-ovoid, of five or six volutions. Spire rather small and short, rapidly tapering. Suture simple, linear, rather shallow.

Whorls rather narrow, adpressed round the suture, moderately convex, but flattened about their centre. Body-whorl nearly two-thirds the height of the shell, voluminous, being much larger, more swollen and convex than the rest of the spire, gently arching below round the base of the shell. Columella long, rounded, straight, tapering, apparently somewhat twisted. No umbilicus. Mouth large, pointed above, extended below. Inner lip diffuse. Shell-structure thick. Surface marked with irregular growth-lines.

Size.—Height 45 mm., width 26 mm.

Localities.—There are three specimens from Wolborough in Mr. Vicary's Collection, and four others from the same locality, chiefly very poor, in the Museum of Practical Geology. In the Torquay Museum are two other much smaller specimens from Barton or Lummaton, and another from Wolborough; and a still smaller specimen from Chudleigh is in Mr. Vicary's Collection. Three specimens in the Woodwardian Museum from Plymouth, which have been described by M'Coy, belong, I believe, to the same species.

Remarks.—This species appears to be distinguished from the others that accompany it by its shortish ovoid form, its small, rapidly increasing spire of few convex whorls, its large, long body-whorl, long columella, and large mouth. Mr. Vicary's largest Wolborough example is very fine, but, having suffered from an almost obliterated fracture, its shape is rather misleading, while its surface is not sufficiently preserved to show whether it was smooth. It may be noticed that to its apex a small specimen of *Davidsonia Verneuillii*, Bouchard, is attached, though this is not shown in the figure. Of the shells figured by Phillips it most resembles *Macrocheilus imbricatus*, Phill., Pl. XXXIX, fig. 194 *b*, not Sow., but it is much more elongate and has a more conical spire and larger body-whorl than that fossil. Mr. Roberts was inclined to identify it with *Macrochilina subcostata*, Schlotheim, when we examined it together, chiefly on account of the flattening about the sutures; but I am not convinced of the correctness of this view, as it is a distinctly shorter shell with more convex whorls; and if it agrees, as I believe it does, with the other specimens with which I have classed it, it certainly cannot belong to Schlotheim's species.

The specimen in the Torquay Museum is the one which agrees best with those M'Coy described. That from Chudleigh is a very small shell, and in it the body-whorl is proportionately smaller and the sutures shallower. The former difference is, however, probably due to its youth, and the latter may be accounted for by its having preserved the outer layer of the test, which is more or less wanting in the other specimens. I am inclined to think that the above examples all belong to the same species, and that they are distinct from the other shells of the same genus that accompany them.

Sowerby, in the 'Min. Conch.,' figures under the name of *Buccinum imbricatum*

two shells from the "Carboniferous Limestone of Bradley, near Newton Abbot," which appear to me to belong to two different species: one, I think, is a specimen of this species; and the other of *M. subcostata*. His description is not specifically identifiable.

M'Coy says, "The greater abrupt convexity of the middle part of the body-whorl, and the contracted, more slender spire easily distinguish this species from the Carboniferous *Buccinum imbricatum* or *acutum*, Sowerby, with which it has been confounded." He does not, however, seem to have observed that Sowerby's original *B. imbricatum*, though described as Carboniferous, came from "Bradley," which probably means Wolborough, and therefore that they were Devonian shells.

The minute shell described by von Eichwald as *M. lævis* seems to me so similar to the smallest of our figured specimens, that I think it must be regarded as in all likelihood the fry of this species.

Affinities.—I have been in much doubt whether this species agrees with *Phasianella ventricosa*, Goldfuss;[1] but I am inclined to think it must be separated on account of its shorter spire, its larger and higher body-whorl, and the much greater elongation of its mouth. On the other hand, it seems somewhat like *Ph. ovata*, Goldfuss,[2] but differs from it by being a broader shell, so that I hardly think it can be the same shell. Sandberger[3] unites these two species under the name of *M. ventricosus*, but neither of his figures resembles the English shells.

Macrochilus imbricatus (Sow.), F. A. Römer[4] and Clarke,[5] differs in having a smaller spiral angle, and a finely imbricated surface.

5. Macrochilina subimbricata, *d'Orbigny*, sp. Pl. XVII, figs. 5—7.

1841.	Macrochilus imbricatus, *Phillips* (pars).	Pal. Foss., p. 104, pl. xxxix, fig. 194 *b* (only).
1849.	—	subimbricatus, *d'Orbigny* (pars).	Prodrome, p. 63.
1889.	—	tumescens, *Whidborne*.	Geol. Mag., dec. 3, vol. vi, p. 30.

Description.—Shell large, turbinated, smooth, acuminate. Spire elevated, conical, of five or six rapidly and regularly increasing volutions. Sutures linear, simple. Whorls somewhat convex, adpressed against the suture above. Body-whorl very convex, and rather more prominent laterally than the other whorls

[1] 1844, Goldfuss, 'Petref. Germ.,' vol. iii, p. 113, pl. cxcviii, fig. 14.
[2] Ibid., p. 113, pl. cxcviii, fig. 15.
[3] 1853, Sandberger, 'Verst. Rhein. Nassau,' p. 233, pl. xxvi, figs. 15, 15 *a*.
[4] 1843, F. A. Römer, 'Harz.,' p. 30, pl. v, fig. 11.
[5] 1884, Clarke, 'Neues Jahrb. f. Min.,' Beil.-Band iii, p. 367, pl. v, figs. 19, 20.

thickened, rapidly tapering. Mouth pointed above, dilate, rather produced and rounded below. Outer lip convex, meeting the columella at a right angle. Shell-structure thin.

Size.—Height 34 mm., width 21 mm.

Locality.—Wolborough. There are three specimens in the Museum of Practical Geology, a fine and exactly similar specimen in the Torquay Museum, and a specimen in Mr. Vicary's Collection.

Remarks.—This shell seems to me exactly to agree with *Phasianella ventricosa*, Goldfuss, except that the mouth is not so produced in front, and this appearance may be due to the imperfection of the German specimen.

Affinities.—These shells differ from the species next described, by their much greater breadth, their more expanded mouth, and their shorter columella; from *Macrochilus ventricosus*, Goldf., as given by M'Coy, by their longer spire and less swollen body-whorl; and from *Macrochilina elevata* by their shorter and slighter spire. A distinctive feature in the species seems to be the form of the spire, the enveloping angle of which increases downwards, so that it is more tapering at the top than near the body-whorl. *M. ventricosus*, Barrois,[1] is a narrower shell with a larger body-whorl.

7. MACROCHILINA, aff. ACUTA, *Sowerby*, sp. Pl. XVII, figs. 10, 10 *a*.

? 1853. MACROCHILUS OVATUS, *Sandberger*. Verst. Rhein. Nassau, p. 284, pl. xxvi, figs. 16, 16 *a* (not Goldfuss).

Description.—Shell rather small, elongate, slender, of about six volutions. Apex sharp or acuminate. Sutures simple, linear. Spire elongate, more than half the height of the shell, regularly increasing, and very conical. Whorls adpressed against the suture, otherwise moderately and evenly convex. Body-whorl nearly half the height of the shell, moderately convex, curving in somewhat rapidly round the base of the shell. Inner lip flattened, diffuse, probably callous. Columella elongate, straight, tapering, rounded, about a quarter the height of the shell. Mouth elongate, large, pointed above, extended below. Outer lip convex, with its curvature increasing downwards, and meeting the end of the columella almost at a right angle.

Size.—Height 28 mm., width 15 mm.

Locality.—Wolborough. There is a single specimen in Mr. Vicary's Collection.

Remarks.—This specimen is distinguished from the others that accompany it

[1] 1889, Barrois, 'Faun. Calc. d'Ebray,' p. 222, pl. xv, figs. 11 *a*, *b*.

by its elongate slender form, by its narrow spire, which is about the same height as the body-whorl, by the extension of the mouth below, and by its long straight columella. It is very closely allied to *M. ventricosa* (fig. 8), from which it chiefly differs by its much more slender shape.

In general shape it very closely corresponds with *Macrochilus ovatus*, Sandberger, but, its surface being absent, it is impossible to say whether it bore any striæ, as given by that author.

Affinities.—From *M. elevata* it is distinguished by its larger body-whorl and smaller spire, and from *M. subimbricata*, d'Orb., sp., by its smaller body-whorl, larger spire, and more conical or fusiform shape. It very closely resembles *M. ovatus*, F. A. Römer,[1] but is a much larger and more acute shell than that species.

The shell, which Sowerby states to be common in the Plymouth Limestone, and quotes in the 'Geological Transactions' as *Buccinum imbricatum*, bears much resemblance to this species, but I am inclined to think that his figure really represents a worn specimen of *M. subcostata*, Schlotheim, sp.

I have been in much doubt whether this was the shell described by Goldfuss as *Phasianella fusiformis*,[2] but I now believe that it is to be distinguished by its convex whorls and broader form, and that Goldfuss's figure belongs to the species which will be described on the next page, and which is certainly distinct from the present form.

It only differs from *Macrochilus acutus*, Sow.,[3] as given by De Koninck,[4] in having less convex or globose whorls, and I am very doubtful if it can be separated from that Carboniferous shell.

Macrochilus Dunkeri, Holzapfel,[5] differs, according to Clarke,[6] in being a slighter shell, with a deeper suture and much broader and more convex whorls.

Subulites priscus, Eichwald,[7] is a much slighter and a beautifully imbricated shell, with lips of a different character.

[1] 1850, F. A. Römer, 'Beitr.,' pt. 1, p. 35, pl. v, fig. 16.

[2] 1844, Goldfuss, 'Petref. Germ.,' p. 113, pl. cxcviii, fig. 16.

[3] 1827, Sow., 'Min. Conch.,' vol. vi, p. 127, pl. dlxvi, fig. 1 (not Sow., 'Geol. Trans.,' ser. 2, vol. v, pt. 3, pl. lvii, fig. 23).

[4] 1842–4, De Koninck, 'Desc. Anim. Foss.,' p. 473, pl. xl, figs. 10 *a*, *b*, and pl. xli, figs. 13 *a*, *b*.

[5] 1882, Holzapfel, 'Gon.-Kalk von Adorf.;' 'Palæontographica,' vol. xxviii, p. 250, pl. xlviii, fig. 4.

[6] 1884, Clarke, 'Neues Jahrb. f. Min.,' Beil.-Band iii, p. 367, pl. v, figs. 22, 23.

[7] 1860, Eichwald, 'Lethæa Ross.,' p. 1128, pl. xliii, figs. 8 *a*, *b*.

8. MACROCHILINA ELEVATA, n. sp. Pl. XVII, figs. 11, 11 *a*, 12, 12 *a*.

Description.—Shell small, elongate, spirally conical, of five or six volutions. Spire considerably more than half the height of shell, regularly increasing. Suture shallow, obtuse. Whorls broad, flatly convex except at base, where they slightly overhang the lower suture. Body-whorl small, curving in rapidly below. Mouth widely ovate.

Size.—Height 17 mm., width 9 mm.

Localities.—There is a specimen in the Museum of Practical Geology from Wolborough, and another in my Collection from Lummaton.

Remarks.—The materials for describing this species are very poor and scanty, the Wolborough specimen being much worn away, while the other is so obscured with matrix that it is difficult to decipher its form. Nevertheless the shell differs so much from the accompanying species that it certainly must be regarded as distinct from them, and I am not aware of any other fossil with which it could be united.

It is distinguished by its regular conical form, its large spire, its small body-whorl, and apparently by the comparative flatness of its base.

I have given a name to this species with much hesitation on account of the poorness of the available specimens. It must be regarded as only tentative, although my strong impression is that further material will prove it to be distinct from any described form of the genus.

9. MACROCHILINA EJECTA, n. sp. Pl. XVII, fig. 13.

1844. PHASIANELLA FUSIFORMIS, *Goldfuss* (not *Sowerby*). Petref. Germ., vol. iii, p. 113, pl. cxcviii, figs. 15 and 16.

Description.—Shell small, rather elongate, spirally conical, of four or five volutions. Suture linear, shallow, oblique. Whorls broad, almost flat, rapidly increasing. Body-whorl large, more than half the height, flat and sloping in the upper half, then becoming gently convex, as it turns through almost a blunt angle to form the oblique base. Columella long, twisted. Mouth large, somewhat lozenge-shaped. Surface smooth.

Size.—Height 12 mm., width 6 mm.

Localities.—From Barton there is a small but perfect specimen in the Lee Collection in the British Museum, and from Wolborough there are two imperfect

examples in the Museum of Practical Geology, and two very poor specimens which appear to belong to the same species in Mr. Vicary's Collection.

Remarks.—This species seems sufficiently distinct. It is marked by the almost conical form of the spire, caused by the flatness of the whorls and their regular decrease in size, and by the large body-whorl, which is symmetrical with the whorls of the spire. The species which most nearly approaches it is *Macrochilina elevata*, but that shell has a longer spire and more convex whorls.

These Devonshire shells seem specifically identical with *Ph. fusiformis*, Goldfuss; but totally differ from the Ordovician *Buccinum fusiforme*, Sow.,[1] whose whorls are as wide as high, and which appears to belong to this genus. *M. ventricosus*, Sandberger,[2] appears to have a longer spire, more convex whorls, and a shorter and wider body-whorl. Sandberger's two figures, however, seem rather different.

In general shape it agrees exactly with *Loxonema fusiforme*, F. A. Römer,[3] and *L. ovatum*, F. A. Römer,[4] but it differs in being smooth instead of striated. Clarke's[5] description shows that it only differs from *L. fusiforme*, F. A. Römer, in not bearing striæ.

10. Macrochilina cyclostoma, n. sp. Pl. XXVII, fig. 1.

Description.—Shell small, elevated, conical, of five or six whorls. Apex acuminate. Suture wide, moderately deep. Whorls decidedly and evenly convex, much exposed. Body-whorl about two-fifths the height of the shell. Mouth subcircular. Outer lip convex and much expanded. Inner lip concave, oblique below, callous, somewhat thickened. Surface smooth. No umbilicus.

Size.—Height 9 mm., width 6 mm.

Locality.—Lummaton (?). There is a single small specimen in the Torquay Museum.

Remarks.—Much cannot be said about the little fossil here described, the single specimen of it which I know being so embedded in the matrix that only one side of it is exposed. I was at first inclined to place it in the genus *Turbo* or *Phasianella*, on account of the shape of its mouth. It differs from the species of *Macrochilina* which accompany it in this particular, and in the exposure and

[1] 1839, Sowerby, in Murchison's 'Sil. Syst.,' p. 642, pl. xx, fig. 19.
[2] 1853, Sandberger, 'Verst. Rhein. Nassau,' p. 233, pl. xxvi, figs. 15, 15 *a*.
[3] 1850, F. A. Römer, 'Beitr.,' pt. 1, p. 35, pl. v, fig. 13.
[4] Ibid., p. 35, pl. v, fig. 16.
[5] 1884, Clarke, 'Neues Jahrb. f. Min.,' Beil.-Band iii, p. 366.

convexity of its whorls and the shortness of its body-whorl. Other species, however, of this genus described by de Koninck and other authors appear to approach it in these characters much more nearly, and to permit it to be included within the generic bounds; and I therefore temporarily place it here, pending more light being thrown upon it by the discovery of further specimens.

Affinities.—It appears exceedingly like the Carboniferous *Macrochilina Phillipsiana*, de Koninck.[1] The shape and size of its mouth is almost the same as in that shell; the inner lip is callous and continuous, and the slope of the columella is similar, but its whorls are fewer and broader, and their curvature shows a greater amount of convexity near the suture. *Macrochilus Dunkeri*, Holzapfel,[2] though very similar is a wider shell with a rather shorter spire, and with a large body-whorl, which is more than half the height of the shell.

2. *Genus.*—Loxonema, *Phillips*, 1841.

Long spiral shells with simple apertures, effuse below, with no umbilicus, and with sharp, more or less curving striæ, belong to this genus, which extends from the Silurian to the Trias.

Where, as in our fossils is often the case, the mouth is defective, it is often very difficult to say whether shells should belong to this genus or to *Holopella*.

1. Loxonema Rœmeri, *Kayser*. Pl. XVII, figs. 18, 18 *a*, 19.

? 1835. Rissoa ? Lefeburii, *Léveille*. Mém. Soc. Géol. Fr., vol. ii, pt. 1, p. 40, pl. ii, fig. 25.

1840. Terebra nexilis, *Sowerby* (pars). Geol. Trans., ser. 2, vol. v, pt. 3, pl. liv, fig. 17 (smaller figure only).

? 1853. Loxonema obliquiarcuatum, *Sandberger*. Verst. Rhein. Nassau, p. 231, pl. xxvi, figs. 12, 12 *a*.

1866. Holopella subulata, *F. A. Römer*. Beitr., pt. 5, p. 8, pl. ii, fig. 4 (not F. A. Römer, Harz., p. 31, pl. viii, fig. 12).

1878. Loxonema Rœmeri, *Kayser*. Abhandl. Geol. Specialk. Preuss., Band ii, pt. 4, p. 108, pl. xvii, figs. 3, 3 *a*.

[1] 1881, de Koninck, 'Ann. Mus. Roy. H. N. Belgique,' vol. vi, pt. 3, p. 36, pl. iv, figs. 4, 5.

[2] 1882, Holzapfel, 'Palæontographica,' vol. xxviii, p. 250, pl. xlviii, figs. 4, 4 *a*, 4 *b*.

1879. LOXONEMA SICULA, *Hall*. Pal. New York, vol. v, pt. 2, p. 43, pl. xxviii, figs. 1—3.

1882. — ANGULOSUM, *Barrois*. Mém. Soc. Géol. Nord, vol. ii, No. 1, p. 278, pl. xiii, fig. 5.

Description.—Shell small, very elongate, subulate, acuminate, of very many whorls. Whorls rather broad, being in height about two-thirds the diameter of the shell at that point; moderately and evenly convex. Suture simple, shallow. Ornamentation consisting of strong, regular, slightly arched, sharp ridges, concave towards the mouth, their curvature being greatest on the shoulder, and on the whole tending rather forwards from apex to base; divided by wider furrows; about twenty or thirty ridges on each whorl.

Size.—A specimen in the Museum of Practical Geology, consisting of the seven upper whorls, is 18 mm. in length.

Localities.—There is a specimen from Wolborough in the Museum of Practical Geology, and another from Lummaton in my Collection. A specimen from South Petherwyn is in the Woodwardian Museum.

Remarks.—This was evidently a very beautiful shell. Its transverse ridges are just visible to the naked eye. They appear to have increased gradually in number as it advanced in age, the new ridges sometimes starting in the centre of the whorl, and thus causing a variation in the amount of arching in the neighbourhood. My specimen from Lummaton is very poor and much obscured by the matrix, which may account for the divergency of shape which is seen in it.

The specimen in the Woodwardian Museum is the smaller of the two shells figured by Sowerby as *L. nexile*. It evidently differs very widely from his other specimen, which has generally been accepted as the type of that species, and it therefore remains without a name. It consists of two apical whorls in a beautiful state of preservation.

Sandberger's figure of his *Loxonema obliquiarcuatum*[1] seems only to differ from the English fossils in being slightly less elongate, and in having slightly more numerous striæ bent more forward. I am rather inclined to believe that it may be the same species, but the difference in height prevents me from uniting them decisively at present, or from using Sandberger's name for our English fossils. It is perhaps intermediate between this species and *L. nexile*.

Loxonema sicula, Hall,[2] also seems to agree exactly in shape and ornament with the present shell. The only difference discernible, which does not seem of specific importance, is a narrow flat band below the suture in the American shell.

[1] 1853, Sandberger, 'Verst. Rhein. Nassau,' p. 231, pl. xxvi, figs. 12, 12*a*.

[2] 1879, Hall, 'Pal. N. Y.,' vol. v, pt. 2, p. 43, pl. xxviii, figs. 1—3.

L. Roemeri, Kayser, though a much smaller fossil, also seems the same. Kayser distinguishes his shell, which is the same as *L. subulatum*, Römer, 'Beitr.,'[1] from *L. subulatum*, Römer, 'Harz.,'[2] which is a very different shell, being much more elongate and having much broader whorls.

L. angulosum, Barrois (not F. A. Römer), is also evidently the same shell.

Affinities.—*L. nexile* differs from this species by having twice as numerous and more recurved ridges, and broader whorls.

L. angulosum, F. A. Römer,[3] differs in being slightly keeled above, in having fewer striæ, and in being a very much shorter shell.

L. funatum, F. A. Römer,[4] has the striæ much more twisted and prominent.

L. reticulatum, Phillips,[5] is distinguished by its shorter spire, greater apical angle, and by its spiral threads.

Holopella moniliformis, F. A. Römer,[6] seems only to be distinguished by its having considerably longer whorls.

Loxonema terebra, F. A. Römer,[7] has much broader whorls, coarser striæ, and apparently a much more elongate form.

Loxonema terebra, Hall,[8] chiefly differs in having its striæ more numerous and recurved. Whether Hall, who does *not* quote Römer, intended, by using the same name, to identify this species with the German shell I cannot say; but, after a careful comparison of the figures of the English, American, and German (Römer's) shell, I think that there is reason to believe that the latter (which is very poor and indistinct) represents a different species from either of the former.

A Carboniferous shell, *Rissoa ? Lefeburii*, Leveillé,[9] is, judging from Leveillé's figure, so similar that it might well be identical; but it does not seem safe to assume this, or to use Leveillé's name for the Devonshire shell, for as figured by Goldfuss this Belgian species is a much shorter shell with finer striæ, and it has been united by Bronn[10] and others, with *Melania subsulcosa*, Phillips,[11] which differs from our Devonian shell in the same respects.

[1] 1866, F. A. Römer, 'Beitr.,' pt. 5, p. 8, pl. ii, figs. 4 *a*, *b*.

[2] 1843, F. A. Römer, 'Harz.,' p. 31, pl. viii, fig. 12.

[3] 1850, F. A. Römer, 'Beitr.,' pt. 1, p. 3, pl. i, fig. 5.

[4] 1855, ibid., pt. 3, p. 14, pl. iii, fig. 18.

[5] 1841, Phillips, 'Pal. Foss.,' p. 139, pl. lx, fig. 187*.

[6] 1866, F. A. Römer, 'Beitr.,' pt. 5, p. 8, pl. ii, figs. 5 *a*, *b*.

[7] 1850, ibid., pt. 1, p. 35, pl. v, fig. 15.

[8] 1876, Hall, 'Illustr. Dev. Foss. Gast.,' pl. xiv, figs. 6, 7; and 1879, ibid., 'Pal.N. Y.,' vol. v, pt. 2, p. 48, pl. xiv, figs. 6, 7.

[9] 1835, Leveillé, 'Mém. Soc. Géol. Fr.,' vol. ii, pt. 1, p. 40, pl. ii, fig. 25.

[10] 1848, Bronn, 'Handbuch,' vol. iii, p. 288.

[11] 1836, Phillips, 'Geol. Yorks.,' vol. ii, p. 228, pl. xvi, fig. 1 *a*.

L. commune, Maurer, agrees perfectly with Phillips's upper figure, and I have no doubt of its identity with this species.

L. nexile, Œhlert, seems to be the same from his description, though his figure (perhaps from its roughness) appears rather more coarsely striated.

Affinities.—There is very little to distinguish the figures of *Loxonema Hennahianum*, Sowerby,[1] from the present species, and if we judged by them alone we should be obliged to unite the two. However, Sowerby describes the former as having distinctly finer and straighter striæ than the present shell, and with this clue differences may be made out in the drawings. Most probably the ornamentation in the figure of *L. Hennahianum* has been represented roughly, and therefore does not appear to be so fine as it is in reality. The whorls also in that shell seem narrower, and the spire is decidedly shorter. We shall see that there is every reason to identify with that species a shell from Lummaton, which differs widely from the present form in the points which we have just enumerated, and which in all probability belongs to the genus *Holopella*.

From *Loxonema sinuosum*, Sowerby sp.,[2] the present species is easily distinguished by its much broader whorls and straighter ridges, which meet at a definite angle at the suture instead of forming continuous sinuations across the whorls. That shell was originally described by Sowerby from the Aymestry Rock, and is, as I believe, correctly identified by Phillips[3] from South Petherwyn. A beautiful example of it from the latter locality is in the British Museum, which shows admirably the sinuous character of the striæ, and proves that M'Coy was wrong in supposing the *L. sinuosum* of Phillips to be the same as *L. nexile*.

L. obliquiarcuatum, Sandberger,[4] approaches our shell very nearly, but is a decidedly shorter shell with narrower whorls, and has coarser ridges.

L. costatum, Goldfuss sp., MS., as described by Sandberger,[5] is much shorter, has much narrower whorls, and is much more obliquely striated.

L. angulosum, F. A. Römer,[6] differs in being much shorter and having much fewer and less arched striæ.

L. funatum, F. A. Römer,[7] has much coarser striæ with a different curvature, forming a reversed "S" with a very small upper lobe.

In *Turritella lineata*, Münster,[8] the whorls are decidedly broader and the

[1] 1840, Sowerby, 'Geol. Trans.,' ser. 2, vol. v, pt. 3, pl. lvii, fig. 22; and 1841, Phillips, 'Pal. Foss.,' p. 99, pl. xxxviii, fig. 184.

[2] 1837, Sowerby, in Murchison's 'Sil. Syst.,' p. 619, pl. viii, fig. 15.

[3] 1841, Phillips, 'Pal. Foss.,' p. 99, pl. xxxviii, fig. 182.

[4] 1853, Sandberger, 'Verst. Rhein. Nassau,' p. 231, pl. xxvi, figs. 12, 12 *a*.

[5] Ibid., p. 230, pl. xxvi, figs. 11, 11 *a*.

[6] 1850, F. A. Römer, 'Beitr.,' pt. 1, p. 3, pl. i, fig. 5.

[7] 1855, ibid., pt. 3, p. 14, pl. iii, fig. 18.

[8] 1840, Münster, 'Beitr.,' pt. 3, p. 89, pl. xv, figs. 21 *a*, *b*.

suture much deeper. The striæ also seem to arch in the reverse direction, though it may be questioned how far their figure accurately depicts them.

Holopella subulata, F. A. Römer,[1] as given in his later work, has fewer and straighter striæ and shorter whorls. It has been renamed *L. Rœmeri* by Kayser, as Römer's earlier figure represented a totally different species.

Loxonema pexatum, Hall,[2] *L. Hamiltoniæ*, Hall,[3] *L. rectistriatum*, Hall,[4] and *L. delphicola*, Hall,[5] are all very kindred species, but differ in having much shorter whorls. It is quite possible, however, that *L. Hamiltoniæ* may be, as Hall at first thought, a variety of Sowerby's *Loxonema nexile*.[6]

3. Loxonema reticulatum, *Phillips*. Pl. XVIII, figs. 1—3.

1841. Loxonema reticulata, *Phillips*. Pal. Foss., p. 139, pl. lx, fig. 187*.
1841. — ? præterita, *Phillips*. Pal. Foss., p. 100, pl. xxxviii, figs. 187 *a*, *b* (not *c*).
? 1844. Melania deperdita, *Goldfuss*. Petref. Germ., vol. iii, p. 109, pl. cxcvii, fig. 12.
1853. Loxonema reticulata, *Sandberger*. Verst. Rhein. Nassau, p. 231, pl. xxvi, figs. 13, 13 *a*.
1854. — reticulata, *Morris*. Cat. Brit. Foss., p. 255.
1857. — striata, *Eichwald*. Bull. Soc. Nat. Moscow, p. 160.
1860. Macrochilus striatus, *Eichwald*. Lethæa Rossica, p. 1118, pl. xliv, figs. 14 *a*, *b*.
? 1887. Loxonema, sp., *Tschernyschew*. Mém. Com. Géol. Russ., vol. iii, No. 3, p. 171, pl. v, figs. 12, 13.
1888. — reticulata, *Etheridge*. Foss. Brit., vol. i, Pal., p. 163.
1888. — præterita, *Etheridge*. Ibid., p. 163.

Description.—Shell large, spiral, many-whorled, turreted, elongate, pointed. Whorls seven or eight, regularly increasing, evenly convex, slightly flattened immediately below the suture, covered by numerous sigmoidal, perpendicular, distant threads, which are crossed by similar and equally distant spiral threads, so as to form a rough reticulation clearly visible to the naked eye. Body-whorl rapidly rounding in below. Aperture subcircular. Columella straight, somewhat produced below. Suture simple, shallow, thread-like. Shell-structure thick.

[1] 1866. F. A. Römer, 'Beitr.,' pt. 5, p. 8, pl. ii, figs. 4 *a*, *b*.
[2] 1879, Hall, 'Pal. N. Y.,' vol. v, pt. 2, p. 42, pl. xiii, figs. 13, 16, 18.
[3] Ibid., p. 45, pl. xiii, figs. 15 and 17.
[4] Ibid., p. 130, pl. xxviii, figs. 9, 9 *a*.
[5] Ibid., p. 47, pl. xiii, figs. 19—25, and pl. xiv, figs. 1, 2.
[6] 1843, Hall, 'Geol. N. Y. Surv. 4th Geol. Dist.,' p. 201.

Size.—A specimen in Mr. Vicary's Collection measures 90 mm. in height, and 33 mm. in width.

Localities.—Wolborough, Chudleigh. There are two specimens from Wolborough in Mr. Vicary's Collection, and two from the same locality in the Museum of Practical Geology, one of which is Phillips's figured type. There are also two specimens in the Museum of Practical Geology, which are Phillips's types of his species *L. præteritum*.

Remarks.—This is a very well-defined and large species. Phillips's original specimen is of a comparatively small example, and other specimens are much larger, and show that the shell-structure generally became extremely massive in old age. Phillips's figs. 187 *a* and *b* of his *L. præteritum* are very roughly and inaccurately drawn. The two specimens are moulds in relief lying in slabs, in which the outline of the shell itself is marked by a white line of calcareous spar, which from its position seems to give an exaggerated appearance of thickness to the shell-structure. They present few points available for specific determination, but as far as can be seen they so closely resemble the other specimens of *L. reticulatum* that I have little doubt of their belonging to the same species. Phillips's third figure of his *L. præteritum*, which is in the same Museum, is from a poor and crushed specimen of a much smaller shell from Hope's Nose, and I am at present inclined to regard it as specifically distinct.

Goldfuss gives the name of *Melania deperdita* to a large cast which seems to me to correspond with the casts of this species.

Macrochilus striatus, Eichwald, is described from a single fragmentary specimen, which appears to be just similar to the upper whorls of the English shells.

The large casts of *Loxonema* figured by Tschernyschew are very similar, but are perhaps more elongate with fewer whorls. They are, however, apparently much distorted.

One of Mr. Vicary's specimens, though very large, has a comparatively thin shell, and the ornament is much finer than is usual in this species.

4. Loxonema ? sp. Pl. XVIII, fig. 4.

Description.—Shell of moderate size, spiral, somewhat elongate, conical, of several whorls. Sutural angle rather great, variable. Whorls probably five or six, short, convex above, flat below. Suture rather deep. Surface ornamented near the suture with indistinct threads sloping obliquely backwards. Body-whorl rather large. Mouth somewhat produced below. Shell-structure thin.

Size.—Height probably about 30 mm., width 12 mm.

from Brushford described in the 'Pal. Foss.' under the name of "*Loxonema rugifera*," Phillips,[1] belongs to the same species as the Yorkshire shell. It is much more similar to the present form, but, as Mr. Roberts agrees with me in thinking, quite distinct from it. Its whorls are narrower and more convex, the ridges appear fewer, and there are varices present of which there are no indications in the Wolborough fossil. Holzapfel, on the other hand, describes under the name of *Holopella scalariæformis* a shell from Adorf, which is very defective, consisting of a single whorl in poor condition, but which, as far as can be seen, there is every reason to regard as agreeing with our English specimen. It seems, moreover, exactly to correspond with the shell described by Trenkner and Clarke under the name of *L. rugiferum*.

Affinities.—*Loxonema funatum*, F. A. Römer,[2] differs from it in having its transverse ridges much arched and oblique, instead of being straight and almost parallel to the apical perpendicular.

In *Loxonema angulosum*, F. A. Römer,[3] the ridges are more arched and much more numerous, and the whorls more evenly convex.

Chemnitzia rugifera, de Koninck,[4] agrees with the Yorkshire and not with the present species.

6. Loxonema conicum, n. sp. Pl. XVIII, figs. 7, 7 *a*, 8.

Description.—Shell large, spiral, very elongate, many-whorled. Suture small, simple, hardly indenting the outline of the side. Whorls very broad, overlapping the suture, with almost flat sides. Body-whorl curving in very suddenly below to form the base of the shell. Aperture apparently not much expanded or produced below. Surface finely reticulate, having sharp and irregularly distant longitudinal lines sloping rather backward from above, and rather smaller and more numerous sharp spiral lines. Base of shell apparently smooth.

Size.—Height of specimen containing three whorls 37 mm., width 19 mm.

Locality.—There is a fine, though characteristically worn, specimen from Wolborough in the Battersby Collection of the Torquay Museum, which consists of the three lower whorls; and two smaller specimens from Lummaton (?) in the same Museum, which have entirely lost the shell and are somewhat crushed, but which probably belong to the same species, though they might almost as well belong to *Holopella*.

[1] 1841, Phillips, 'Pal. Foss.,' p. 101, pl. xxxviii, fig. 188.
[2] 1855, F. A. Römer, 'Beitr.,' pt. 3, p. 14, pl. iii, fig. 18.
[3] 1850, ibid., pt. 1, p. 3, pl. i, fig. 5.
[4] 1842–4, de Koninck, 'Desc. Anim. Foss.,' p. 462, pl. xli, fig. 2.

Remarks.—This shell approaches *Loxonema reticulatum* in its general shape and its markings, but it differs in having hardly any indentation at the suture, and in its whorls being almost flat and much broader. Its mouth also appears to be smaller and less produced below, and its ornamentation seems somewhat coarser and sharper. Mr. Roberts and I, on examining it together, came to the conclusion that in all probability it is a distinct species. The material, however, at our command is very scanty and difficult to decipher, so that it is quite possible that these differences may ultimately prove to be due to accident or specific variation. At the same time, as far as can be at present seen they appear so numerous and distinctive, that it seems unwise to include it as a variety in Phillips's species. The existing whorls would lead to the supposition that it was much more elongate than that species, and had still more numerous whorls.

7. LOXONEMA PRISCUM, *Münster*, sp. Pl. XVIII, figs. 17—19.

? 1837.	TURRITELLA OBSOLETA, *Sowerby*.	Murchison's Sil. Syst., p. 603, pl. iii, figs. 7 *a*, 12 *f*.
? 1837.	— GREGARIA, *Sowerby*.	Ibid., p. 603, pl. iii, fig. 1 *f*.
1840.	MELANIA PRISCA, *Münster*.	Beitr., pt. 3, p. 83, pl. xv, fig. 1.
1853.	HOLOPELLA PILIGERA, *Sandberger*.	Verst. Rhein. Nassau, p. 228, pl. xxvi, figs. 9, 9 *a—c*.
1881.	LOXONEMA DEORNATUM, *de Koninck*.	Annales Mus. Royal H. N. Belg., vol. vi, p. 47, pl. iv, figs. 24, 25.
1882.	HOLOPELLA PILIGERA, *Holzapfel*.	Palæontographica, vol. xxviii, p. 249.
1889.	— — *Whidborne*.	Geol. Mag., dec. 3, vol. vi, p. 30.

Description.—Shell small, elongate, slender, spiral, of many volutions. Sutural angle small, constant. Suture linear, deep. Whorls nine or ten, smooth, broad, regularly convex. Body-whorl rather larger and broader in proportion than the penultimate whorl, slightly flattened in the middle, curving rather suddenly to form the base of the shell. Aperture subcircular, rather large. Columella strong, straight, rather long, being about half the length of the mouth. Inner lip diffuse, callous. Outer lip semicircular. Surface smooth.

Size.—Height 21 mm., width 5 mm.

Localities.—From Wolborough there are two or perhaps three specimens in Mr. Vicary's Collection, one in the Museum of Practical Geology, and one in the Torquay Museum. From Lummaton there are two specimens in the Battersby Collection of the Torquay Museum.

Remarks.—The type specimen of the present species as occurring in Devonshire is the fine example figured in Pl. XVIII, fig. 19. Most of the other speci-

mens are poor and give few specific marks apart from their general shape, but on the whole they appear to belong to the same species. Mr. Vicary's two specimens were labelled by Salter "*Holopella piligera*, Sandberger," and to the broader variety of that species they present so close a resemblance that there would be no doubt of their identity were it not that the whorls of our type specimen have the appearance of being perfectly smooth, whereas Sandberger's shell appears to be marked with very fine and indistinct transverse threads. In the basal part of our specimen, however, there are some very faint indications of similar markings, and therefore it appears best to regard it as at most a smooth variety of the German shell. The circular mouth, the strong columella, and the expanded body-whorl seem to be distinctive features; it is possible, on the other hand, that the bottom of the shell though appearing perfect may be really defective, and that its true termination may be gone.

Melania prisca, Münster,[1] is a smooth shell which is remarkably similar in general appearance. It chiefly differs in being somewhat more elongate and in having broader whorls. The mouth in Münster's figure is evidently either defective or misdrawn, and hence it is impossible to say whether the two shells belong to the same genus, but their general appearance would lead to the supposition that they did so; and, as the specimens which Sandberger figures of his shell vary far more in their elongation and the breadth of their whorls than would cover the distance between the English shell and Münster's specimens, the only remaining point in question is the smoothness. In that the English shell agrees with Münster's, and therefore it appears needful to regard them as the same species.

Affinities.—This shell differs from its accompanying congeners in its slender shape and its smoothness, as well as in the other points just mentioned. Sandberger remarks that his shell comes very near to, and perhaps may be identical with, *Turritella obsoleta* and *gregaria*, Sowerby. These shells from Horeb Chapel are certainly very similar to ours, and are described as smooth; but they are in the form of casts, and it is therefore not very easy to be certain whether they are identical or not. The chief differences appear to be that their whorls are decidedly more convex, and that their shape seems broader. I am, however, very doubtful whether they would prove distinct if the original specimens were compared. Sandberger also compares his species with *Melania subangulata*, *M. deperdita*, *M. absoluta*, and *M. antiqua*, four badly preserved species, described by Goldfuss[2] in the 'Petref. Germ.,' which, however, all distinctly differ.

[1] 1840, Münster, 'Beitr.,' pt. 3, p. 83, pl. xv, fig. 1.

[2] 1844, Goldfuss, 'Petref. Germ.,' p. 109, pl. cxcvii, figs. 11—14.

their surface, slightly convex near the sutures, and slightly overhanging the lower suture.

Size.—A fragmentary specimen measures about 33 mm. in height and about 16 mm. in diameter.

Locality.—Wolborough. There is a specimen in the Museum of Practical Geology, another in the Torquay Museum, and a third in Mr. Vicary's Collection.

Remarks.—These fossils are all very defective, and preserve no trace of either the surface-markings, or the base, or the aperture, so that it is impossible to determine whether any part of the body-whorl remains. Their shape, however, is peculiar, and quite different from any of the other fossils that occur in these localities. They are distinguished by their conical form and their flattish narrow whorls. The specimen in the Torquay Museum appears to be deformed, as the apical part of it is considerably recurved, so that the perpendicular from the apex perhaps fell actually outside the circumference of the base. The nucleus is present, and is rather larger than the proximate whorl, which is very irregular, and accounts for much of the deformity. The whorls in this specimen seem narrower and more convex than those of the other, so that I am not certain whether it belongs to the same species, but it is in such a poor state of preservation that but little can be made of it.

Melania subangulata, Goldfuss,[1] has a much wider and deeper suture.

As far as can be judged from the cast, this shell comes very close to *Michelia exaltata*, F. A. Römer.[2] It has about the same apical angle, but is specifically distinguished by having somewhat broader and more convex whorls, although not nearly so much so as *Michelia distracta*, F. A. Römer.[3] It is, however, so similar that it most probably belongs to the same genus as do those shells.

4. *Genus.*—SPANIONEMA,[4] gen. nov.

Shell very elongate, turriculated, of many almost wholly exposed, narrow, convex whorls. Mouth subcircular, produced below. Surface probably smooth, bearing occasional discontinuous varices. Umbilicus minute.

The position of this genus (or perhaps sub-genus), which is formed for the species described below, seems to me at present doubtful. In general shape it approaches *Loxonema*, two or three species of which have been described as bearing varices; and near this genus, by the advice of Mr. Etheridge, I have provisionally

[1] 1844, Goldfuss, 'Petref. Germ.,' vol. iii, p. 109, pl. cxcvii, fig. 11.

[2] 1852, F. A. Römer, 'Harz.,' pt. 2, p. 74, pl. xi, fig. 17.

[3] Ibid., pt. 2, p. 74, pl. xi, fig. 18.

[4] From σπάνιος, rare, and νῆμα, a thread.

striæ. Römer identifies that shell with *Phasianella subclathrata*, F. A. Römer,[1] which differs from our shell in its shortness, the apparent absence of an umbilicus, the shape of the inner lip and of the body-whorl, and the possession of longitudinal striæ. It does not, I think, belong to the same genus, for the possession of varices is almost the only point in common.

Scalaria antiqua, Münster,[2] is a much shorter shell, and has no varices.

Loxonema rugiferum, Phillips,[3] 'Pal. Foss.' (not 'Geol. Yorkshire'), appears to be something of the same shape and to have a few varices, but it also has very strong and numerous longitudinal ridges.

Loxonema læve, F. A. Römer,[4] which according to Clarke[5] bears varices, differs in having fewer and very much broader whorls.

II. *Family.*—Littorinidæ, *Gray.*

1. *Genus.*—Littorina, *Férussac*, 1821.

I have had the advantage of submitting several of the Devonian shells described below to Mr. E. A. Smith of the British Museum, and he agrees with me that there is no reason for separating them from the recent genus. Of course there is a possibility that these shells might be referred to the Turbinidæ, as it is impossible to say that they were not nacreous. But there is no reason for supposing that they were so, and I know of no case in which a shelly operculum that might belong to them has occurred in our Devonian rocks.

1. Littorina devonica, *Whidborne.* Pl. XIX, figs. 5, 5 *a*.

1889. Littorina devonica, *Whidborne.* Geol. Mag., dec. 3, vol. vi, p. 30.

Description.—Shell small, fusiform, turreted, ovoid, turbiniform, of few (three or four) volutions. Spire rather large, obtuse. Apex blunt. Suture obtuse and shallow. Whorls convex, very rapidly increasing, ornamented with spiral lines of nodules becoming ridges on the front part of the shell, crossed by numerous close irregular growth-lines, tending obliquely backwards from the rear to the front of the whorl. Ornament of the body-whorl consisting of a small high hem,

[1] 1843, F. A. Römer, 'Harz.,' p. 31, pl. viii, fig. 15.
[2] 1839, Münster, 'Beitr.,' pt. 1, p. 61, pl. xiii, fig. 1.
[3] 1841, Phillips, 'Pal. Foss.,' p. 101, pl. xxxviii, fig. 188.
[4] 1850, F. A. Römer, 'Beitr.,' pt. 1, p. 35, pl. v, fig. 17.
[5] 1884, Clarke, 'Neues Jahrb. f. Min.,' Beil.-Band iii, p. 365, pl. v, fig. 12.

Turbo cœlatus, Goldf.,[1] is more globular, has a flat band following the suture, which makes the mouth more square above, and its ornament is uniform.

2. Littorina Ussheri, n. sp. Pl. XIX, figs. 6—8.

Description.—Shell rather small, short, globose, oblique, smooth. Suture simple, obtuse, shallow. Spire short, obtuse, convex, of about four narrow, little exposed, and rapidly increasing whorls. Apex acuminate. Whorls rather broad, convex, rather flatter on the back, gently and obliquely rounding in to the base. Mouth entire, continuous, oblique, pear-shaped, rather elongate, pointed above, roundly convex and rather produced below. Outer lip moderately convex. Inner lip nearly straight, thick, diffuse, flattened, spreading over and partially or wholly covering the umbilicus with a callosity, bearing a broad, low, flat, very indistinct tooth in the centre of the aperture, in front of which it trends in an oblique curve round the front of the mouth, and has along its centre a distinct, shallow, rounded groove. Surface covered with multitudinous, indistinct, microscopical, transverse striæ or growth-lines, so fine that the shell appears smooth to the naked eye. Shell-structure thick.

Size.—Height 13 mm., width about 11 mm.

Localities.—There is a large specimen in my Collection from Lummaton, and four small specimens in Mr. Vicary's Collection from Chudleigh.

Remarks.—It is with some doubt that I place these specimens together, as they present some differences, and it is possible that better specimens may prove them to belong to two distinct though closely allied species. My specimen, which wants is much the spire, the largest shell; it shows the low tooth on the inner lip, and the covered umbilicus; and the front part of the inner lip seems perhaps shorter and less distinctly grooved than it is in Mr. Vicary's fossils. In these latter the lip shows hardly any trace of a tooth, and its callosity is less defined and extends further over the base of the shell. It is, however, possible that these differences may be due to age or contortion from which the Chudleigh specimens have considerably suffered, and at all events the material at hand is quite insufficient to show them to be distinct.

Affinities.—From *Naticopsis primigenia*, Eichwald,[2] this species differs in being more oblique, and in having a stouter shell, a smaller and less circular mouth, a spreading inner lip, and a longitudinal groove.

From *Plagiothyra archon*, mihi, it differs by being of a more globose form, with a smaller spire and a much more elongate and differently formed mouth.

[1] 1844, Goldf., 'Petref.,' vol. iii, p. 90, pl. cxcii, figs. 3 *a*—*c*.

[2] Eichwald, 'Leth. Ross.,' p. 1106, pl. xliv, figs. 6 *a*, *b*.

Turbo inflatus, Münster,[1] has a much larger spire, a smaller apical angle, and a shorter body-whorl.

Ampullaria Ponti, Goldf.,[2] differs in being more globose and minutely striated, in having the lips disjoined, and in the inner lip not being callous.

Natica striolata, F. A. Römer,[3] and *Natica spirata*, F. A. Römer,[4] are somewhat similar forms, but are striated.

Natica marginata, F. A. Römer,[5] and *Natica inflata*, F. A. Römer,[6] also seem similar, but they are striated, longer, and less oblique. The former, however, which has a shorter spire and is a smaller shell than the latter, looks very much like our species. Clarke,[7] however, states that it is distinguished by a spiral depression on the whorls below the suture.

Turbo inflatus, Münster,[8] according to Tietze,[9] seems to be a more globose shell with a rather higher spire. It comes very close to the present form in general shape, but is certainly, if Münster's original figure is to be trusted, distinct from it.

III. *Family.*—Naticidæ, *Forbes.*

1. *Genus.*—Naticopsis, *M'Coy.*

The shells in this genus are very similar in general shape to the true *Naticæ*. They are frequently of large size, and are generally smooth, but occasionally are longitudinally striated. They are not umbilicated. The lips are continuous, and the inner lip is often very diffuse and callous. They extend from the Devonian to the Trias.

1. Naticopsis harpula, *Sowerby*, sp. Pl. XIX, figs. 3, 3 *a*, 4.

1827. Murex harpula, *Sowerby*. Min. Conch., vol. vi, p. 152, pl. dlxxviii, fig. 5.
1832. Nerita subcostata, *Goldfuss*. In De la Beche's Handbook (German edition), p. 532.

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[1] 1840, Münster, 'Beitr.,' pt. 3, p. 90, pl. xv, fig. 25.
[2] 1844, Goldf., 'Petref. Germ.,' vol. iii, p. 114, pl. cxcviii, figs. 17 *a*, *b*.
[3] 1850, F. A. Römer, 'Beitr.,' pt. 1, p. 33, pl. v, figs. 7 *a*, *b*.
[4] Ibid., pt. 1, p. 34, pl. v, fig. 10.
[5] 1843, F. A. Römer, 'Harz.,' p. 27, pl. vii, figs. 6 *a*, *b*.
[6] Ibid., p. 27, pl. vii, figs. 8 *a*, *b*.
[7] 1884, Clarke, 'Neues Jahrb. f. Min.,' Beil.-Band iii, p. 354.
[8] 1840, Münster, 'Beitr.,' pt. 3, p. 90, pl. xv, fig. 25.
[9] 1870, Tietze, 'Dev. Schicht. Ebersdorf,' p. 39, pl. ii, fig. 24.

1840. MUREX HARPULA, *Sowerby*. Geol. Trans., ser. 2, vol. v, pt. 3, pl. lvii, fig. 21.
1841. MACROCHEILUS HARPULA, *Phillips*. Pal. Foss., p. 105, pl. xxxix, fig. 197.
1842. NATICA SUBCOSTATA, *d'Archiac* and *de Verneuil*. Geol. Trans., ser. 2, vol. vi, pt. 2, p. 366, pl. xxxiv, figs. 5, 6.
1844. — — *Goldfuss*. Petref. Germ., vol. iii, p. 116, pl. cxcviii, figs. 22 *a—c*.
1849. MACROCHEILUS HARPULA, *d'Orbigny*. Prodrome, p. 63.
1849. TURBO SUBCOSTATUS, *d'Orbigny*. Ibid., p. 66.
1854. MACROCHEILUS HARPULA, *Morris*. Cat. Brit. Foss., p. 256.
1876. NATICA SUBCOSTATA, *F. Römer*. Lethæa Pal., pl. xxxii, fig. 8.
1888. MACROCHEILUS HARPULA, *Etheridge*. Foss. Brit., vol. i, Pal., p. 163.
1889. LITTORINA SUBCOSTATA, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 30.
1889. TURBO SUBCOSTATUS, *Nicholson*. Manual of Palæontology, 2nd edition, vol. i, p. 775, fig. 668.

Description.—Shell small, globose, of few (two or three) very rapidly increasing whorls. Sutures wide. Whorls starting convexly from the suture, somewhat obliquely flattened on the back, so that the lower part of the whorl is widest, and there curving evenly round the front of the shell to form the base; ornamented by coarse, round, transverse ribs, separated by interstices of a similar width, which start from the suture and proceed obliquely backwards about one-third the breadth of the whorl, when they divaricate and bend for a short distance still more backward, so that the front part of the whorl has twice as small and numerous ribs as the upper part. Mouth entire, large, oval, produced in the antero-exterior direction. No umbilicus. Shell-structure very massive. Apex acute.

Size.—A large specimen measures about 32 mm. in height. A more perfect small specimen measures 9 mm. in height and 10 mm. in width.

Locality.—Chudleigh, "Bradley, Plymouth."[1] There are three specimens from the first locality in Mr. Vicary's Collection, one of which is as large as d'Archiac's type, and another small but very perfect.

Remarks.—There can be no question about the identity of these Chudleigh fossils with the German species described by d'Archiac and de Verneuil, Goldfuss, &c., as they correspond with it in every particular. Its name was given originally in MS. by Goldfuss, and is quoted without description by von Dechen in his German edition of De la Beche's 'Handbook.'

There is more doubt whether the fossil described by Phillips under the name of *Macrocheilus harpula* (Sow.) belongs to the present species. In general appearance and markings it closely resembles it, but Phillips's description presents some divergences; *e. g.* according to it, the spire is more elongate, the base of the columella is more thickened, and there is a plain longitudinal band running along the centre

[1] 1841, Phillips, 'Pal. Foss.,' p. 105.

1. NATICA? NEXICOSTA, *Phillips*. Pl. XIX, fig. 1.

1841.	NATICA NEXICOSTA, *Phillips*.	Pal. Foss., p. 95, pl. xxxvi, figs. 174 *a*, *b*.
1845.	LITTORINA BISERIALIS, *de Verneuil*.	In Murch., Vern. and Keys., Russia, vol. ii, p. 340, pl. xxiii, fig. 13.
? 1853.	— LIRATA, *Sandberger*.	Verst. Rhein. Nassau, p. 220, pl. xxv, figs. 15, 15 *a*, 15 *b*.
1854.	NATICA NEXICOSTA, *Morris*.	Cat. Brit. Foss., p. 263.
1857.	LITORINA GLOBOSA, *Eichwald*.	Bull. Soc. Nat. Moscow, p. 162.
1860.	NATICA GLOBOSA, *Eichwald*.	Lethæa Ross., p. 1123, pl. xlii, fig. 20.
1870.	— NEXICOSTA, *Tietze*.	Dev. Schicht. Ebersdorf, p. 40, pl. ii, fig. 25.
1888.	— — *Etheridge*.	Foss. Brit., vol. i, Pal., p. 164.
Not 1843.	— — *F. A. Römer*.	Harz., p. 27, pl. vii, figs. 5 *a*, *b*.

Description.—Shell small, subglobular, pointed, of about three rapidly increasing whorls. Spire short, broadly conical, about one-third the height of the shell. Suture well defined, obtuse. Upper whorls roundly step-like, much enveloped, their width about equal to their height above the suture. Body-whorl very large and capacious, starting obliquely from the suture, rather flatter on the back, and rounding in to form the base of the shell. Ornament consisting of very strong, elevated, steep, subacute, longitudinal ridges, separated by similar furrows, about thirty on the body-whorl, sloping obliquely backwards from the suture, becoming more perpendicular in the back, and again tending rather backwards near the base of the shell, often divaricating close to the upper suture. Base and mouth hidden in the described specimen.

Size.—Height 12 mm., width 11 mm.

Locality.—There is a small specimen from Lummaton in the Woodwardian Museum, and a larger specimen in the Battersby Collection of the Torquay Museum, apparently from the same place. I have also seen a specimen in the Champernowne Collection, which I believe to belong to the same species.

Remarks.—The above description is taken from the shell in the Battersby Collection. It is to be noticed that all the ribs do not start from the suture, but that some either rise or divaricate almost immediately below it. It is almost exactly similar to the South Petherwyn shell to which Phillips gave the name *Natica nexicosta*, Phillips; the only difference being that there are no signs of any of the ribs divaricating upwards as his figure indicates, but some of them are shorter, as he mentions, or at least divaricate downwards close to the suture. I do not think that these points are likely to indicate any specific difference, and have no hesitation in placing our shells under Phillips's species; they are alike in shape, and the number and style of the ribs exactly correspond.

There is much more doubt whether *Littorina lirata*, Sandberger, is the same

Description.—Shell very small, subglobose, turbiniform, pointed, of about four very rapidly increasing whorls. Spire broadly conical. Suture well defined, rectangular. Upper whorls small, low, rounded, step-shaped, the width from the suture being rather less than the height of the exposed part. Body-whorl very capacious and oblique; in section spreading out at first perpendicularly from the suture, and soon rounding with an almost semicircular curvature over the back to the oblique base of the whorl. Ornament consisting of very fine and numerous close, rounded, regular, microscopical, longitudinal threads, crossing the whorl obliquely backwards from the suture. Mouth defective, but probably very large and spreading.

Size.—Height about 7 mm., width 8 mm.

Locality.—There is a small specimen in the Torquay Museum, which seems to have come from Lummaton.

Remarks.—The small specimen described above undoubtedly belongs to *Natica piligera*, Sandberger, with which it agrees accurately as far as the English specimen will admit comparison. The drawing given of it (Pl. XIX, fig. 2) does not perhaps present a sufficient obliquity of the lower slope of the whorls, so that it is really rather wider and more oblique than there indicated. It will be seen by Sandberger's figures that the shell varies considerably in shape. In the Torquay specimen there is a decided umbilicus, but in Sandberger's figures it is represented as closed by the callosity of the inner lip. This is probably due to the fact that the body-whorl is really broken away in the Torquay fossil, so that the true aperture is not seen.

Natica antiqua,[1] Goldfuss, appears to be so similar that I think it must be regarded as the same species, and if so this name has the priority. His figure gives the impression of being less oblique and having a longer spire than Sandberger's shell, but as the shells are figured in different aspects, and as the two figures given by Sandberger vary much in obliquity, it is not easy to draw any specific distinction between them.

Natica efossa, another fossil described by Goldfuss,[2] seems to have rather coarser and more irregular striæ, and to be a little more oblique, but these differences are so slight that I am disposed to regard it as the same shell.

Again, in *Natica interstrialis*, F. A. Römer,[3] the striæ seem more irregular and unequal, but it is similar in shape and may be identical, especially as Römer mentions that he has only observed the inequality of striation upon the penultimate whorl of his figured example.

Under the name of *Natica nexicosta*, F. A. Römer figures a shell which differs

[1] 1844, Goldfuss, 'Petref. Germ.,' vol. iii, p. 117, pl. cxcix, figs. 2 *a*, *b*.

[2] Ibid., p. 117, pl. cxcix, figs. 3 *a*, *b*.

[3] 1850, F. A. Römer, 'Beitr.,' pt. 1, p. 34, pl. v, figs. 11 *a*, *b*.

widely from Phillips's type. It has much finer and more numerous striæ, and is more depressed, and so is very similar to the present shell. Though the striæ are visible on Römer's small figure, and are therefore represented as decidedly coarser than in ours, Mr. Roberts agree with me in thinking that this may be due to the necessities of the drawing, and therefore that it may perhaps be intended for the present species. Römer, however, mentions shorter swellings between the main ribs, and, if they exist, it is unlikely to be a synonym of this shell.

In my Collection is a fragment from Lummaton which consists of a single defective whorl marked in a similar manner. It more probably, however, belongs to a Holopella, or even to a Goniatite, than to a Natica.

Affinities.—This species differs from *Natica nexicosta*, Phillips, in having much finer, closer, and more regular ribs, which never show any tendency to divaricate, and in being less elongate.

Natica striolata, F. A. Römer,[1] and *N. spirata*, F. A. Römer,[2] are more ovate and elongate forms.

Naticopsis elegantula, Œhlert and Davoust,[3] is almost exactly similar in shape and longitudinal striation, but differs in being covered with microscopic spiral lines.

Natica inflata, F. A. Römer[4] and Tietze,[5] which is similarly striated, is a less oblique shell, and has a higher spire.

Natica modesta, "Barrande MS.," as given by Maurer,[6] approximates it in shape, but is described as smooth.

Natica Adorfensis, Holzapfel,[7] appears to be distinguished by possessing coarser striæ.

Ampullaria Ponti, Goldfuss,[8] is another shell which nearly corresponds, but is differentiated by having its striæ less oblique, and by possessing a few coarse folds immediately below the suture-line.

[1] 1850, F. A. Römer, 'Beitr.,' pt. 1, p. 33, pl. v, figs. 7 *a*, *b*.
[2] Ibid., p. 34, pl. v, fig. 10.
[3] 1880, Œhlert and Davoust, 'Bull. Soc. Géol. Fr.,' ser. 3, vol. vii, p. 712, pl. xv, figs. 3, 3 *a*—*c*.
[4] 1843, F. A. Römer, 'Harz.,' p. 27, pl. vii, fig. 8.
[5] 1872, Tietze, 'Dev. Schicht. Ebersdorf,' p. 40, pl. ii, fig. 26.
[6] 1880, Maurer, 'Neues Jahrb. f. Min.,' Beil.-Band i, p. 32, pl. ii, fig. 13.
[7] 1882, Holzapfel, 'Palæontographica,' vol. xxviii, p. 250.
[8] 1844, Goldf., 'Petref. Germ.,' vol. iii, p. 114, pl. cxcviii, figs. 17 *a*, *b*.

3. NATICA MERIDIONALIS, *Phillips ?* Pl. XVII, figs. 15, 15 *a*, 15 *b*.

? 1841. NATICA MERIDIONALIS, *Phillips*. Pal. Foss., p. 94, pl. xxxvi, fig. 173.
? 1854. — — *Morris*. Cat. Brit. Foss., p. 263.
? 1888. — — *Etheridge*. Foss. Brit., vol. i, Pal., p. 164.

Description.—Shell small, ovoid, turbiniform. Spire low, convex, of about four whorls. Suture deep. Whorls narrow, convex, less than half exposed, very rapidly increasing. Body-whorl about two-thirds the height of shell, voluminous, evenly convex, and turning in to form an obliquely rounded base. Surface almost smooth, marked by a few indistinct ridges or growth-lines, starting perpendicularly from the upper suture, and vanishing as they slope backwards on the middle of the whorl. Mouth large, wide; apical portion obtuse; lower extremity evenly rounded. Inner lip apparently straight. Signs of a small umbilicus. Shell-structure rather thick.

Size.—Height 9 mm., width 6 mm.

Locality.—Wolborough. A single specimen is in Mr. Vicary's Collection.

Remarks.—This is a pretty little species, but the only example I know is too defective to enable me to determine its position positively. It is a very small shell, but a line along the centre of its largest whorl seems to indicate that the true body-whorl is absent. Nevertheless its form is certainly peculiar. The spire is low and convex in outline, owing to the proportionately increasing rapidity of diminution. More than half the whorls are covered by those succeeding, and where exposed at the base of the specimen they appear to be of a similar convexity all through. The rounding-in of the shell below seems to indicate the existence of an umbilicus, but as that part is choked with matrix, this cannot be certainly asserted. The ornament is very faint, but the surface appears somewhat worn.

I am in great doubt as to whether this is the shell represented by Phillips as *N. meridionalis*. His description is very slight, and his figure very sketchy. When examined under a lens the latter appears to be similar in shape to our shell, but the striæ certainly show no signs of turning backward as they vanish. It is, however, possible that this might have been unnoticed by Phillips; and, as I have been unable to meet with his type specimen, I think it best for the present to include the Wolborough fossil under his name.

IV. *Family.*—Velutinidæ, *Gray*, 1840.

1. *Genus.*—Strophostylus, *Hall*, 1879.

This genus or sub-genus is separated from *Platyostoma* by having a twisted columella and by not being umbilicated. It belongs to the Upper Silurian and the Devonian formations.

The shell described below is referred to it with much hesitation, because it seems, as far as can be judged from the defective state of the specimens, to resemble the shells placed under this genus by Hall and by Œhlert.

1. Strophostylus, sp. Pl. XIX, figs. 11, 11 *a*.

? 1870. Natica, sp., *Tietze*. Dev. Schicht. Ebersdorf, p. 41, pl. ii, figs. 27, 27 *a*.

Description.—Shell rather large, spiral, of few volutions, subglobose. Spire small, low, flattened above. Suture small and deep. Whorls less than half exposed, very convex on the shoulder, less convex on the back. Surface smooth. Body-whorl large and voluminous. Shell-structure thick.

Size.—Height 15 mm., width 24 mm., but the measured specimen is probably crushed and distorted.

Locality.—There are two specimens in the Lee Collection in the British Museum, labelled "Lummaton," but their mineral character is so different from the generality of Lummaton fossils that I have little doubt that there is some error, and that they came from another locality, possibly from Chircombe Bridge. Though I have introduced them here, they must certainly be excluded from the Lummaton list.

Remarks.—This species seems most probably to belong to the genus *Strophostylus;* but, the aperture of both specimens being obliterated and the shape contorted, it is almost impossible to make any positive generic identification.

Affinities.—It appears to be a more definitely coiled shell than *Strophostylus Cheloti*, Œhlert.[1]

It is very similar to *Platyostoma Giebeli*, Kayser,[2] but its spire is higher and is more distinctly coiled.

[1] 1887, Œhlert, 'Bull. Soc. d'Étud. Sci. d'Angers,' p. 6, pl. vi, figs. 8—8 *d*.

[2] 1878, Kayser, 'Abhandl. Geol. Specialk. Preuss.,' Band ii, pt. 4, p. 99, pl. xvi, figs. 1—3.

2. *Genus.*—PLATYOSTOMA, *Conrad*, 1842.

These shells are low, subglobose, and umbilicated. The spire is of few whorls, and increases rapidly and somewhat asymmetrically. The mouth is more or less pentangular in shape. The genus occurs in the Silurian, Devonian, and Carboniferous formations.

Some of the species described below show considerable likeness to the *Ianthinidæ* in the shape of the mouth, but, on the other hand, they appear in some other respects to be related to the *Capulidæ;* and, after a comparison with several foreign species of *Platyostoma,* it has seemed best to group them under that genus, and to follow Zittel in ranking them among the *Velutinidæ.*

1. PLATYOSTOMA SIGMOIDALE, *Phillips* sp.? Pl. XIX, figs. 9, 10, 10 *a*.

? 1840. ACROCULIA SIGMOIDALIS, *Phillips*. Pal. Foss., p. 94, pl. xxxvi, fig. 170.
1854. CAPULUS SIGMOIDALIS, *Morris*. Cat. Brit. Foss., p. 239.
1858. — NATICOIDES, *Giebel* (not *F. A. Römer*). Sil. Faun. Unterharz., p. 26, pl. iii, fig. 7.
NATICA GREGARIA, *Barrande*, MS.
1878. PLATYOSTOMA NATICOIDES, *Kayser*. Abhandl. Geol. Specialk. Preuss., Band ii, pt. 4, p. 100, pl. xvi, figs. 4, 4 *a*.
1888. ACROCULIA SIGMOIDALIS, *Etheridge*. Foss. Brit., vol. i, Pal., p. 163.

Description.—Shell small, spiral, very oblique, and flattish. Spire depressed and very obtuse, formed of about three flat and very rapidly increasing whorls. Suture well defined, obtuse. Whorls rising convexly from the suture, and then spreading out with a gradually increasing curvature till they turn with a slight blunt angle to the lower parts of the shell, along which a slight shallow, indistinct groove or depression is developed near the mouth. Surface ornamented by very numerous, regularly undulating, longitudinal, microscopic, sharpish lines, separated by shallow furrows, which are visible also on the mould, and are arranged in groups of two or three, occasionally divaricating, and sometimes crossed and partially reticulated by still finer spiral striæ. Mouth very large, oblique, with wavy lips. Shell-structure very thin. Colour black.

Size.—Height 8 mm., width 15 mm.

Locality.—Lummaton. There is a specimen in the Torquay Museum upon a slab with *Terebratula juvenis*, as well as a second specimen in the same Museum, and a third in my Collection.

Remarks.—The above description is taken from the first of these shells, which I at first thought to be distinct from the other two. Afterwards, upon re-examining them in company with Mr. Thomas Roberts, F.G.S., we came to the conclusion that they were all of one species, and that they belonged to *Acroculia sigmoidalis*, Phillips, the type specimen of which is in the Museum of Practical Geology, and is a small and much-crushed shell from Hope's Nose. In this shell the " much-bent striæ, reticulated on the outer part of the whorl," described by Phillips, are decidedly coarser than they are in our own examples.

These Lummaton fossils very closely approach the group of Capulidæ, with well-developed spires, oblique mouths, and a single spiral furrow running up a short distance from the front of the outer lip. The grouping of the ornament into sets is peculiar, and is more easily observed on the mould than on the exterior of the shell itself. It is either formed by the threads being occasionally a little stronger, or by slight undulations in the growth of the shell itself.

Our species seems identical with the shells referred by Giebel[1] and Kayser[2] to *Acroculia naticoides*, F. A. Römer.[3] The undulating longitudinal striation is the same in each; and the chief difference between them, as far as I can see, is that the English form is a little less oblique. This might easily, however, be accounted for by supposing a little contortion to have occurred in the course of fossilization. I cannot, however, think that the two later authors are correct in identifying their fossil with Römer's species. That shell seems totally different in shape, being much more globular with a much higher body-whorl; and its striæ form a single slightly arched curve instead of being regularly undulating, as in their German and our English shell. Kayser refers it to the genus *Platyostoma*, Hall, and states that *Natica gregaria*, Barrande, MS., is probably the same species. No signs of the reticulation which is observable upon Phillips's type specimen appear to be visible on any of the German shells.

Affinities.—In *Pileopsis lineata*, Goldfuss,[4] the spire is much larger, and the longitudinal lines much less undulating.

[1] 1858, Giebel, 'Sil. Fauna Unterharz.,' p. 26, pl. iii, fig. 7.

[2] 1878, Kayser, 'Abhandl. Geol. Specialk. Preuss.,' Band ii, pt. 4. p. 100, pl. xvi, figs. 4, 4 *a*.

[3] 1852, F. A. Römer, 'Beitr.,' pt. 2, p. 101, pl. xv, fig. 16.

[4] 1844, Goldfuss, 'Petref. Germ.,' vol. iii, p. 9, pl. clxviii, fig. 2.

2. PLATYOSTOMA ? DEFORME, *Sowerby* sp. Pl. XXIII, figs. 1—5.

1840. NERITA DEFORMIS, *Sowerby*. Geol. Trans., ser. 2, vol. v, pt. 3, pl. lvii, fig. 14.
1845. — SPIRATA, *Sowerby*. Ency. Metrop., p. 578.
1854. — DEFORMIS, *Morris*. Cat. Brit. Foss., p. 264.
1889. — — *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 30.

Description.—Shell rather small, subglobose, spirally conical, of two or three volutions. Spire small, very rapidly increasing, excentric, irregularly coiled. Suture deep, acute. Whorls irregularly convex, more or less elevated above the lower suture; flattened on the basal side, but becoming gradually rounder as they advance from the apex. Body-whorl transversely flattened at first, gradually expanding, so as to become very large and capacious near the mouth; sometimes spirally compressed along its centre, so as almost to form a blunt angle or undeveloped keel. Mouth very large, subcircular, entire. Lips discontinuous. Inner lip replaced for one-third part by the parietal wall. Peristome sharp, bevelled all round. Columella very long, slightly arching and slightly twisted. Umbilicus small and very deep. Shell-structure apparently rather thin. Surface ornamented by very fine, regular, and numerous striæ, arching convexly very rapidly backwards from the suture, but becoming concave and perpendicular upon the centre of the whorl and towards the base of the shell.

Size.—A middle-sized specimen measures 14 mm. in height by 13 mm. in width. A large specimen is 22 mm. wide.

Localities.—From Wolborough there are five specimens in Mr. Vicary's Collection; nine, or perhaps ten, in the Godwin-Austen Collection in the Museum of Practical Geology; two in the British Museum; and seven[1] in the Torquay Museum. From Lummaton there is a small specimen in the Woodwardian Museum.

Remarks.—This species appears to be decidedly common at Wolborough. As far as the state of the specimens will allow a judgment to be formed, it appears to be a distinctly variable shell, especially in the height and shape of its spire. In the young shell this seems to be almost flat, and scarcely indented by the suture-lines, while in the more aged specimens it becomes elevated and subturrited.

The shape of the base of the shell also seems to change with its growth, that of the upper whorls appearing to be flat, while that of the body-whorl gradually becomes convex and produced in front.

[1] Only three of these seven specimens are certainly from Wolborough; the others may be from Lummaton.

Hence the aspect of the shell varies much with its age, or with the point of view from which it is observed. Sometimes it appears almost lenticular, and at others subglobose. Nevertheless it may be regarded as a very well-defined species, for it has clear distinctive features in spite of this tendency to individual variation. Thus the spire has a peculiar and characteristic style of coiling; the body-whorl has one or two spiral flattenings, which break the uniform convexity of its section; the rapid increase and change of shape of the tube gives a characteristic spiral slope to the base; the aperture has an incurved inner lip, and a break between the upper terminations of the two lips; and the style of ornamentation is altogether very unusual and distinctive. This ornament consists of thin, parallel, microscopic striæ, arching backward from the suture until they become almost transverse, and then changing their curvature, and becoming almost longitudinal upon the lower part of the whorl. These lines appear to be structural rather than mere surface-markings, but, as the shells are generally decayed, they can only occasionally be seen.

I am strongly of opinion that this species is the shell referred to by Sowerby in the 'Encyclopædia Metropolitana' as *N. spirata*, and described in the 'Geological Transactions' as *N. deformis*. His description is very slight, and his figure is so poor that neither Mr. Roberts nor myself could feel any certainty about the correctness of its identification with the present shells, some of which have been so labelled in the Godwin-Austen Collection. They certainly can only belong to Sowerby's species if his figures in the 'Geological Transactions' are inaccurate. The back view might agree with them if a little tilted up, but the front view appears to depict a nonumbilicated shell with continuous lips. Hence they ought to represent a shell even of a different genus from the present; but, nevertheless, after a careful comparison of his figures and description with some of the Godwin-Austen specimens I feel very much under the impression that the appearances in his figure are only due to shading, and that the type specimen from Plymouth will be found to belong to the same species as these Wolborough shells.

It is to be noticed that Sowerby described it as finely striated, though the striæ figured are much coarser than those in ours. While, however, several such differences could be pointed out, there is in it such a look of specific resemblance to our fossils that I think they must really be due only to the roughness of Sowerby's drawing.

Affinities.—*Nerita spirata*, Sowerby,[1] from the Mountain Limestone, is very similar, but its ornamentation has a different contour, the shape of its aperture is different, and it has a spiral concavity encircling the whorls just below the suture, of which there is no trace in any of our specimens.

[1] 1824, Sowerby, 'Min. Conch.,' vol. v, p. 93, pl. cccclxiii, figs. 1, 2.

Some, though not all, of the figures given by Hall[1] of *Platyostoma lineatum*, Conrad,[2] bear considerable resemblance to the present species. There is the same variability of shape, but it appears to be upon the whole a flatter form, with generally a less elevated spire, and the character of its ornament is totally different.

3. PLATYOSTOMA SPECIOSUM, *Sowerby*, sp. Pl. XXIII, figs. 6, 6 *a*.

1840. NERITA SPECIOSA, *Sowerby*. Geol. Trans., ser. 2, vol. v, pt. 3, pl. lvii, fig. 15.
1854. — — *Morris*. Cat. Brit. Foss., p. 264.

Description.—Shell small, lenticular, dilate, of rather few whorls. Spire very broadly conical, almost flat externally, but somewhat elevated in the centre. Apex apparently sharp. Suture small but deep. Body-whorl spreading out horizontally from the suture to the shoulder, where, after slightly sinking, it turns through a sharpish angle, and proceeds obliquely inwards to form the base. Umbilicus closed. Mouth large, trapezoidal, somewhat produced below. Lips meeting in front at an obtuse angle. Inner lip much arched.

Size.—Height 6 mm., width 12 mm.

Locality.—A specimen in the Torquay Museum probably comes from Lummaton or Barton. A specimen from Wolborough in the Museum of Practical Geology belongs either to this species or to *Euomphalus circularis*.

Remarks.—*Nerita speciosa* is described by Sowerby as being a species which occurs of all sizes up to several inches in the Plymouth Limestone. Its height is equal to its breadth. The upper whorls are convex, but the body-whorl is marked by a shallow concentric depression between the suture and the shoulder. It will be seen that the small specimen described above does not quite fulfil all these conditions, but is still so similar that it may in all likelihood be regarded as a young specimen of it, in which the concentric depression has not yet developed, or the mouth so much increased in size as to render the height equal to the breadth. Both our specimen and Sowerby's figure are so defective that the full characters of the species cannot be made out.

Affinities.—This shell differs from *Euomphalus circularis*, Phillips,[3] by its acute-angled whorls and its closed umbilicus.

Euomphalus Gualtieriatus, Schlot.,[4] almost exactly corresponds upon the upper

[1] 1879, Hall, 'Pal. N. Y.,' vol. v, pt. 2, p. 21, pl. x, figs. 1—23, 25, 26.
[2] 1842, Conrad, 'Journ. Acad. Nat. Sci. Phil.,' vol. viii, p. 276, pl. xvii, fig. 7.
[3] 1841, Phillips, 'Pal. Foss.,' p. 94, pl. xxxvi, fig. 171.
[4] 1844, Goldfuss, 'Petref. Germ.,' vol. iii, p. 81, pl. clxxxix, figs. 3 *a*, *b*.

side, differing perhaps in the spire forming a slightly convex cone, and in the mouth being smaller; it is, however, at once distinguished by having (as described by Goldfuss) a wide subangulated umbilicus.

Platyostoma turbinatum, Hall,[1] approaches the present form so nearly as to suggest that it very probably belongs to the same genus. The American species is a decidedly more elongated form, with much fewer and more quickly increasing whorls, and curved growth-lines of which we can trace no sign in our English specimens.

V. *Family.*—Capulidæ, *Cuvier.*

1. *Genus.*—Capulus, *Montfort*, 1810.

The palæozoic forms of this group were placed by Conrad under the genus *Platyceras* in 1840, and by Phillips under the genus *Acroculia* in 1841; and these names, as well as some others, have been largely used for them by various authors. There is a vast amount of individual as well as of specific variation in the palæozoic forms of these shells, and it appears to me that they include the recent species of *Capulus* within their limits, although on the other hand they contain many shapes that would not otherwise be included in it. Thus, for instance, the spire is often very asymmetrical and the surface tuberculated or strongly plaited. However, these forms are so closely connected among themselves that it seems impossible to draw any generic distinction between them, and therefore there seems no reason for separating them from the recent genus, which contains only about ten living species—a very small number compared with those of the Silurian and Devonian formations, which are to be counted by hundreds. We therefore can only regard the recent shells as the worn-out representatives of a large and flourishing ancient type.

At the same time, the horseshoe-shaped muscular impression which is so prominent in the modern species is not generally noticeable in the Devonshire fossils when they occur as casts; and, if the shape of this proves to be different, it may be needful to retain the name *Platyceras* as a sub-genus of *Capulus*, or as a distinct genus. At present, however, there seems no reason for doing this, and the best course is to follow Tawney, Kayser, and others, in referring these ancient shells to the genus *Capulus* itself.

It has proved very difficult to decide the specific limits of such shells of this genus as are described below. Hardly two specimens are exactly alike, and the

[1] 1879, Hall, 'Pal. N. Y.,' vol. v, pt. 2, p. 27, pl. ix, figs. 12—24.

material at hand is often quite insufficient to show how far their variation is only accidental or of permanent value. On the other hand, as fresh specimens are examined, the existence of real lines of demarcation becomes increasingly evident. Hence, while it is possible that some of the species now given may have hereafter to be re-united, it seems probable that the number of species will be ultimately found to exceed that which is here recorded.

1. CAPULUS? INVICTUS, n. sp. Pl. XIX, figs. 12—14.

Description.—Shell rather small, depressed, lenticular, regularly coiled. Spire small, contiguous, almost flat but tending upwards, nearly level with the highest plane of the shell, rapidly and regularly increasing, consisting of one or two volutions. Apex minute, recurved, pointed. Body-whorl wider than high; in section suboval or subtriangular, gently rising from the inner or sutural side, spreading out for a great width above, where it is slightly convex and on the whole oblique, rounding so very rapidly as to be almost subangular on the narrow back, and then proceeding inwards in an oblique direction to the lowest part of the shell, where it curves upwards to form apparently an incipient umbilicus; longitudinally, regularly arched, almost keeled on the back, and bearing a more or less defined, broad, shallow groove, midway between the convex back and base of the shell. Mouth oblique, the lower part being less advanced than the upper. Peristome in part wavy or coarsely undulated. Surface ornamented with numerous, superficial, unequal, angulated, broad, flat spiral bands, separated by shallow grooves. Colour black, with broad white spiral bands, following the course of the grooves.

Size.—Height 12 mm., width 21 mm.

Localities.—From Wolborough there is a specimen in Mr. Vicary's Collection; and from Barton and Lummaton two in the Lee Collection in the British Museum, one in the Woodwardian Museum, two in the Bristol Museum, and two in my Collection.

Remarks.—Whether this species is to be regarded as belonging to *Capulus*, or to *Platyostoma*, I am not sure. It appears at all events to be on the border-line of the former genus, its regular symmetrical shape closely connecting it with ordinary spiral forms.

Mr. Vicary's specimen is the only one in which the ornamentation or the colour-bands are visible, but in it the portions of the bands not worn away are beautifully displayed. The other specimens seem smooth; but, as their surface is not well preserved, there is no reason to doubt that they belong to the same

sunk below the highest plane of the shell. Apex minute, incurved, and direct, facing neither upwards nor downwards. Body-whorl very elongate, perpendicularly compressed, and very slowly increasing; in section, broadly oval, most convex round the back which sometimes is almost bluntly angular, less convex above and below; longitudinally convex along the back with a decreasing curvature towards the mouth, definitely concave along the inner side, sometimes showing indistinct longitudinal grooves. Mouth small. Peristome slightly sinuous, not expanded. Surface ornamented with irregular undulating growth-lines and numerous microscopical striæ, crossed sometimes, especially in the lower parts, by occasional fine ridges, in which case the striæ become deeply sinuous between them.

Size.—A specimen in Mr. Vicary's Collection measures—width 16 mm., depth 18 mm., height 12 mm. A specimen in the Woodwardian Museum measures —width 15 mm., depth 12 mm., height 9 mm.

Localities.—From Lummaton there are eight specimens in my Collection and four in the Woodwardian Museum. From Barton there are three specimens in the British Museum, two of which have the lower lip more than usually expanded. From Wolborough there is a specimen in Mr. Vicary's Collection.

Remarks.—This little species seems very well defined, and very different from any of the accompanying forms. It is notable for the very slow rate of increase of its whorl, by the great distance of its apex from the plane of the mouth, and for its great horizontal symmetry. If it be stood on its mouth the perpendicular from the apex falls some distance outside the centre of the inner margin of the aperture.

The shell described by Maurer appears identical with the English form, as far as can be judged from the defective cast which he figures. This shell he submitted to Barrande, who described it as "rapproché de *Capulus rostratus*, Barr., e^2—f^2."

There is the usual amount of variability between individual specimens of this species of *Capulus*, both in the length and curvature of the shell and in other points, but at the same time there is a general similarity which marks them as all belonging to the same species. Perhaps the most aberrant specimen is one in my Collection which is very long and flat and almost rhomboidal in section, being flattened on the back, lateral, and inner sides, and angulated at the corners.

Affinities.—*Orthonychia subrectum*, Hall,[1] is slighter and less recurved.

Platyceras Thetis, Hall,[2] has a longer, freer, and more recurved apex.

One of Kayser's[3] figures of *Capulus Zinckenii*, F. A. Römer,[4] sp., is something

[1] 1859, Hall, 'Twelfth Rep. N. Y. State Cab. Nat. Hist.,' p. 18.

[2] 1879, Hall, 'Pal. N. Y.,' p. 8, pl. iii, figs. 11—16.

[3] 1878, Kayser, 'Abhandl. Geol. Specialk. Preuss.,' Band ii, pt. 4, p. 39, pl. xv, figs. 5—7.

[4] 1843, F. A. Römer, 'Harz.,' p. 27, pl. vii, figs. 4 *a*—*c*.

like Mr. Vicary's specimen, but that species is distinctly different, being more deeply furrowed, twisted, and with a much less recurved umbo. Barrois'[1] figure of the same species also closely resembles it, but may be distinguished by the same particulars; and on the whole I think that, though closely allied, the English and German species are not identical.

3. CAPULUS ROSTRATUS, *Trenkner?* Pl. XX, figs. 6—8.

1852.	PILEOPSIS COMPRESSA, *Quenstedt* (not *Goldf.*).	Handb. Petref., p. 440, pl. xxxv, fig. 11.
? 1853.	CAPULUS GRACILIS, *Sandberger*.	Verst. Rhein. Nassau, p. 236, pl. xxvi, figs. 17, 17 *a*.
? 1867.	— ROSTRATUS, *Trenkner*.	Paläont. Novitat., pt. 1, p. 12, pl. i, fig. 22.
? 1884.	— — *Clarke*.	Neues Jahrb. f. Min., Beil.-Band iii, p. 362, pl. v, figs. 10, 11.

Description.—Shell rather large, very much depressed, lenticular, very short, trigonal. Spire usually much recurved, and consisting of more than a volution, rather depressed below the highest plane of the shell, slightly tending upwards, involute. Apex minute, rather distant from the plane of the mouth. Body-whorl short, rapidly and regularly increasing; very much flattened, being gently convex above, deeply convex on the narrow back, and concave below; horizontally convex along the back, concave on the inner side and nearly straight below. Mouth not expanded, not sinuous except perhaps at the back. Surface marked with numerous, irregular, flattish, arched growth-lines, tending upwards near the back, and crossed by crowded, indistinct and discontinuous, microscopic, spiral striæ.

Size.—Width 34 mm., depth 24 mm., height about 10 mm.

Locality.—A fine and large specimen from Wolborough is in Mr. Vicary's Collection. There are four smaller specimens from Lummaton in my Collection, and one probably from the same locality in the Torquay Museum.

Remarks.—I should at once have placed these shells with the following species, were it not for their greater flatness, for the greater curvature of the back, and for the pronounced spiral concavity of the under side. This last character can only be seen in the two small specimens in my Collection, as Mr. Vicary's large specimen is embedded in the matrix at that part. In that specimen, moreover, the spire is much more recurved, owing probably to its being a much older shell. The above-mentioned features seem to point to the probability of

[1] 1889, Barrois, 'Faun. Calc. d'Ebray,' p. 197, pl. xiii, figs. 6 *a*—*c*.

the present shell proving to be specifically distinct. It appears to be the best course to place it, for the present, under the heading *C. rostratus*, Trenkner, leaving it to be decided whether it should be differently treated when more and better specimens are found.

Capulus rostratus, Trenkn.,[1] as described by him and as given by Clarke,[2] is a smaller form with a less distant and recurved apex and no distinct signs of any basal concavity, but it comes so close that there is a probability that the same species may be intended by the very rough figure of the earlier author.

The next is the only accompanying species to which it could be united, as its great flatness and other characters widely separate it from all the other shapes which occur in the present localities.

Affinities.—*Pileopsis compressa*, Goldfuss,[3] is exceedingly like the exposed side of Mr. Vicary's large specimen, but as described by him and F. A. Römer[4] it appears to want the deep basal concavity seen in the other specimens of the English shell. As given by Barrois,[5] also, it is very like Mr. Vicary's specimen. No basal concavity is, however, noticed by him, the spire is smaller, and there is no notice of any spiral markings. Hence, though coming so close, I do not feel justified in regarding it as identical.

Capulus gracilis, Sandberger, seems to come very near it, though the view given by Sandberger does not render a comparison with our shells very easy, and his description does not help much. It differs somewhat in the elliptic curve of its spire, which is much greater, and there is no sign of the depression on the lower side.

4. Capulus compressus, *Goldfuss*, sp. Pl. XX, figs. 9—11.

1832. Pileopsis compressa, *Goldfuss*. In De la Beche's Handbook (German edition), p. 531.
? 1841. Acroculia vetusta, *Phillips* (pars). Pal. Foss., pl. xxxvi, fig. 169 *c* (only).
1843. — compressa, *F. A. Römer*. Harz., p. 26, pl. xii, fig. 34.
1844. Pileopsis compressa, *Goldf.* Petref., vol. iii, p. 9, pl. clxvii, figs. 18 *a*—*c*.
1846. Acroculia proæva, *Eichwald*. Geogn. Russ., p. 384.
1855. Capulus compressus, *de Verneuil*. Bull. Soc. Géol. Fr., vol. xii, p. 1001, pl. xxix, fig. 1.

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[1] 1867, Trenkner, 'Paläont. Novit.,' pt. 1, p. 12, pl. i, fig. 22.
[2] 1884, Clarke, 'Neues Jahrb. f. Min.,' Beil.-Band iii, p. 362, pl. v, figs. 10, 11.
[3] 1844, Goldfuss, 'Petref. Germ.,' vol. iii, p. 10, pl. clxvii, figs. 18 *a*—*c*.
[4] 1843, F. A. Römer, 'Harz.,' p. 26, pl. xii, fig. 34.
[5] 1882, Barrois, 'Mém. Soc. Géol. Nord,' pl. ii, No. 1, p. 281; pl. xiii, figs. 2 *a*, *b*.

1860. CAPULUS PROÆVUS, *Eichwald.* Lethæa Rossica, p. 1102, pl. xli, figs. 14 *a*, *b*.
1885. — COMPRESSUS, *Clarke.* Neues Jahrb. für Min., Beil.-Band iii, p. 361.
1889. ACROCULIA PROÆVA, *Whidborne.* Geol. Mag., dec. 3, vol. vi, p. 30.

Description.—Shell rather small, very much depressed, lenticular, short, trigonal. Spire little developed, recurved, much less than a volution, much depressed below the highest plane of the shell, but tending slightly upwards, involute. Apex very minute, indistinct, rounded, considerably distant from the plane of the mouth. Body-whorl rather short, rapidly and regularly increasing, very much flattened, showing a very long oval in section; gently convex above and below, slightly flattened on the narrow back; horizontally having a nearly circular curvature on the back, deeply concave on the inner side and slightly concave below. Mouth not expanded, hardly if at all sinuous. Surface marked with irregular growth-lines or fine striæ, which occasionally undulate, and which turn rearwards as they cross the back. Colour pale, marked with a few narrow spiral black streaks.

Size.—A specimen measures 16 mm. in width, 16 mm. in depth, and 13 mm. in height.

Locality.—Lummaton. There are five specimens in my Collection, two in the Woodwardian Museum, and one in the Battersby Collection of the Torquay Museum.

Remarks.—This species is characterised by its great flatness perpendicularly, by its short, subtriangular, and rapidly increasing whorl; by the total absence of longitudinal furrows, and, where seen, by the remarkable spiral colour-bands. This is, in fact, almost the only Devonshire species in which I have observed the remains of colour pattern, and even in this it is only observable in two specimens, the others being either a blackish or pale grey monochrome. It is to be observed that one of the figures (fig. 169 *c*) given by Phillips in his 'Palæozoic Fossils' evidently shows traces of a similar colouring. It represents a considerably larger and higher shell than any of our specimens, but in other respects it corresponds with them, except that its back is more evenly rounded and broader, and possibly it may simply be an old and lofty example of the present species. I am, however, more inclined to regard it as a variety of *Capulus tylotus*, and to think that it represents the same species, and perhaps even the same shell, as that given by Phillips in his fig. 169 *a*. I have been unable to find the originals of these two figures.

This species differs from *C. pericompsus* by its shorter and less tubular form, and the absence of spiral furrows; and from *C. rostratus*, Trenkner, by the much smaller concavity in the lower contour of the shell.

It should be observed that the small specimen given as Pl. XX, fig. 9, is a fragment of the apex, and not a perfect infant shell.

Goldfuss's fig. of *Pileopsis compressa* seems to me to represent either this or the preceding species. I have united with it the fossils now under consideration because there is no sign or mention of a basal groove, but it is questionable whether its spire is too much recurved to agree with either of them.

Capulus rostratus, Trenkner,[1] is distinguished, by its describer, from Goldfuss's species by the sharpness of its back.

5. Capulus puellaris, n. sp. Pl. XX, figs. 12 ?, 12 *a* ?, 13—15.

? Acroculia trigona, *F. A. Römer* (not *Phill.*). Harz., p. 26, pl. xii, figs. 33 *a*, *b*.
? — — *Clarke*. Neues Jahrb. f. Min., Beil.-Band iii, p. 360.

Description.—Shell large, depressed, trigonal, more or less wide. Spire free, recurved, very small, more or less than a volution, depressed below the horizontal plane through the top of the shell. Apex apparently much incurved, minute and facing hardly if at all upwards, overhanging and generally very distant from the plane of the mouth. Body-whorl more or less subcircular in section, generally most convex at the back, of variable width, but generally broader than high; horizontally arched, regularly increasing, and occasionally with short grooves or swellings close to the mouth, not expanded below. Mouth of moderate size, nearly perpendicular to the spire. Peristome more or less sinuous. Surface with irregular undulating growth-lines.

Size.—Width 45 mm., depth 20 mm., height 27 mm.

Localities.—From Wolborough there are two specimens in the Museum of Practical Geology; and from Lummaton there are four specimens in my Collection, two in the Woodwardian, and three in the Torquay Museum, which last seem to belong to the same species, and to come from the same locality. There are four in the British Museum labelled "Barton."

Remarks.—The present form seems distinguished by its minute recurved apex, by its undeveloped, free, hardly elevated spire, by the distance of the apex from the plane of the mouth owing to the great length of the inner side of the body-whorl, and by its trigonal regularly increasing shape. Some of the specimens show signs of indistinct longitudinal folds close to the mouth, and in two of them these folds appear to be numerous, more definite, and more extensive. The surface presents considerable inequalities or irregularities, but for the most part the outer shell is lost, so that its ornamentation cannot be defined.

From the state of the material at my command it is impossible to speak very

[1] 1867, Trenkn., 'Palæont. Novit.,' pt. 1, p. 12, pl. i, fig. 22.

positively of the definiteness or limits of the species, but it appears to represent one if not two forms distinct from those that accompany it. The large specimen, Pl. XX, fig. 12, for instance, has a much more elongated spire, and I am in some doubt whether it might be a variety of *Capulus contortus*, F. A. Römer ?, as it has some indistinct longitudinal markings, and its spire tends upwards; but it is crushed and a cast, and on the whole it seems better to leave it with the present species.

Affinities.—*Acroculia trigona*, F. A. Römer,[1] seems to resemble it in some respects, and may possibly belong to the same species, though it has a larger and contiguous spire; but this species differs from *Pileopsis trigona*, Goldfuss,[2] which is a highly conical shell, with hardly any signs of a spire.

Capulus conspicuus, Eichwald,[3] appears to be distinguished by having a less elongate and recurved beak, and by the total absence of spiral undulations.

6. Capulus terminalis, n. sp. Pl. XX, figs. 16, 16 *a*.

Description.—Shell rather large, depressed, transversely conical. Spire very small, elongate, much recurved, free (?), tending upwards, considerably distant from the oral plane. Body-whorl subcircular or oval in section, flat on the inner side, horizontally very convex with decreasing curvature. Mouth large, hardly if at all sinuous. Surface unknown.

Size.—Width 18 mm., breadth 28 mm., height 27 mm.

Locality.—Lummaton. Two specimens in my Collection.

Remarks.—It is rather doubtful whether this shell may not be only a variety of *Capulus columbinus*, but it seems at present needful to separate it from it on account of its long and free spire standing at a greater distance from its mouth, as well as the more tubular shape of its spire. In both cases the apex is rather imperfect, but in this it was evidently much more elongated than in the other species. The species appears to come midway between *Capulus puellaris* and *Capulus columbinus*.

[1] 1843, F. A. Römer, 'Harz.,' p. 26, pl. xii, figs. 33 *a*, *b*.

[2] 1844, Goldfuss, 'Petref. Germ.,' vol. iii, p. 9, pl. clxvii, figs. 17 *a*—*c*.

[3] 1857, Eichwald, 'Bull. Soc. Nat. Moscov.,' p. 157; and 1860, Eichwald, 'Lethæa Rossica,' p. 1103, pl. l, figs. 12 *a*, *b*.

7. CAPULUS CORDATUS, *Whidborne*, sp. Pl. XXI, figs. 1, 1 *a*.

1889. METOPTOMA CORDATA, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 30.

Description.—Shell rather small, depressed, transversely conical. Spire very small, free, consisting of about one-half of a volution, moderately convex externally, very concave within. Apex minute, sharp, recurved, below the median line of the shell, and tending slightly downwards. Whorls increasing with extreme rapidity; in section, flatly and obliquely convex above, rapidly rounding so as to be almost keeled on the median line, and then turning in with a slightly concave curve on the lower part; inner side very concave. Mouth very large, obliquely heart-shaped or subtriangular. Peristome undulating, flatly expanded nearly all round. Perpendicular from apex falling near, but well within, the inner margin of the mouth.

Size.—Height 14 mm., width 19 mm., distance of the apex from the plane of the mouth 5 mm.

Locality.—There is a single specimen from Wolborough in the Museum of Practical Geology.

Remarks.—This shell seems distinguished by its very large expanded mouth, by its free, acute, and slightly recurved apex, by its almost keeled back, and especially by the extension of the inner side of the mouth beyond the perpendicular let fall upon it from the apex. It is unfortunate that it is represented by only a single specimen, as it becomes very difficult to decide how far the peculiarities in its shape may be due to the accident of the individual, but these are so numerous and so marked that it seems impossible to unite it with any of the accompanying species. I was at first inclined to place it with the shell next to be described, but the shape and freedom and position of its apex seem to prove that it cannot belong to that species.

Affinities.—In *Metoptoma pileus*, Phillips,[1] from the Carboniferous Limestone, the apex is more elevated, and the proximal corners of the mouth more angulated.

Pileopsis cassideus, d'Arch. and de Vern.,[2] has a sharp median keel, a rather greater spire, and a smaller mouth.

[1] 1836, 'Geol. York.,' vol. ii, p. 224, pl. xiv, fig. 7.

[2] 1842, d'Arch. and de Vern., 'Geol. Trans.,' ser. 2, vol. vi, pt. 2, p. 366, pl. xxxiv, fig. 10.

extending beyond the inner margin of the mouth. Spire increasing with extreme rapidity, consisting of less than a volution, not very convex, and spreading out rapidly to the mouth on every side. Spiral contour of the back only slightly convex. Mouth broadly heart-shaped. Surface indistinct.

Size.—Height 17 mm., width 19 mm., distance of apex from plane of mouth 5 mm.

Locality.—There is a specimen, probably from Lummaton, in the Torquay Museum, and another from the same locality in my Collection.

Remarks.—The materials for identifying this species are exceedingly scanty, and it is therefore very difficult to speak with any certainty about it. All that can be said is that it seems so unlike any of the accompanying forms that it must be regarded as most probably distinct. The distinguishing points seem to be its large ovate mouth, its small, advanced, and horizontally straight umbo, and its low flattened contour. *Capulus cordatus* differs in having a free and less curved and more central apex; and *C. squamosus*, Trenkner?, in having its apex more advanced and decidedly curved upwards, and in being horizontally more elongated.

As far as can be judged from our imperfect specimen, it seems to agree with the *C. uncinatus* of F. A. Römer,[1] at least as interpreted by Giebel,[2] and Kayser,[3] except in having no spiral folds upon the body-whorl.

10. Capulus columbinus, *Whidborne* sp. Pl. XXI, figs. 4, 4 *a*, 4 *b*, 5, 5 *a*.

1889. Acroculia columbina, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 30.

Description.—Shell rather large, depressed, globose. Spire very small, rapidly increasing, closely recurved. Apex minute, facing upwards. Body-whorl subcircular in section, more convex above, probably flat on the inner side, rather produced below; horizontally very convex, with decreasing curvature. Mouth large. Peristome occasionally sinuous. Surface covered with very numerous, fine, distinct, undulating growth-lines, crossed by very indistinct microscopical ridges, and sometimes with strong spiral grooves, at which the growth-lines become strongly flounced.

Size.—Width 32 mm., breadth 19 mm., height 29 mm.

Localities.—From Wolborough there is a specimen in Mr. Vicary's Collection; and from Lummaton there are two specimens in my Collection.

[1] 1852, F. A. Römer, 'Beitr.,' pt. 2, p. 101, pl. xv, fig. 15.

[2] 1858, Giebel, 'Sil. Faun. Unterharz.,' p. 20, pl. iii, figs. (16), 19, 20.

[3] 1878, Kayser, 'Abhandl. Geol. Specialk. Preuss.,' Band ii, pt. 4, p. 92, pl. xv, figs. 1—3, 4?, 5.

Taking the figured specimen as the type, the shell is to be defined by its regular and slowly increasing form, its slight, horizontal curvature, and its small rounded apex facing upwards. Of the accompanying species it perhaps most closely resembles *C. Ussheri*, but it differs from it by its more elongate form, its more rounded and blunter and more oblique apex, and in its surface-markings.

Capulus squamosus, Trenkner, as given both by himself and by Clarke, seems so close to this form that they should probably be united under one species.

12. Capulus tylotus, n. sp. Pl. XXI, figs. 9, 9 *a*, 10, 10 *a*; Pl. XXII, figs. 1, 1 *a*, 2, 2 *a*, 2 *b*.

?1841. Acroculia vetusta, *Phillips* (pars). Pal. Foss., p. 93, pl. xxxvi, fig. 169 *a* (and *c*) only.

?1854. Capulus vetustus, *Morris* (pars). Cat. Brit. Foss., p. 239.

Description.—Shell rather large, depressed, narrow, elongate, loosely coiled. Spire large, recurved, consisting of more than a volution, much sunk below the highest plane through the shell, very slightly if at all tending upwards. Apex much recurved, nearly or quite direct. Body-whorl rather short, increasing in a rapidly advancing ratio, much produced below near the mouth so as to form a more or less definite concave "wing," subcircular in section, being almost evenly convex except on the inner side, which is flattened: back convex in horizontal section, with a decreasing curvature, so as to become nearly straight close to the aperture; inner side concave. Mouth not very large, expanding especially on the inner side and below. Peristome slightly sinuous. Surface marked with irregular, sinuous, transverse growth-lines, and fine, crowded, microscopical striæ, crossed by numerous indistinct furrows or folds; and bearing occasional small low tubercles.

Size.—Width 26 mm., depth 18 mm., height 24 mm.

Localities.—From Wolborough there are two specimens in Mr. Vicary's Collection; and from Lummaton there are seven specimens in my Collection, three in the Woodwardian Museum, two in the British Museum, and one in the Torquay Museum.

Remarks.—This species is distinguished by its comparatively well-developed and large spire, its generally almost horizontal symmetry, the considerable distance of its apex from the plane through the mouth, the elegant curves formed by the changes in the spiral curvature of its walls except on the back, the expanding mouth, and especially by the tubercles of its surface.

It does not exactly agree with any of the figures of *Acroculia vetusta* in Phillips's 'Pal. Foss.,' but it presents most likeness to the indistinct fragment given in his fig. 169 *a*, which may perhaps belong to it; and of this, his fig. 169 *c* may perhaps be another view. It appears a sufficiently well-defined form, although there is considerable variation in the growth of the different specimens. It differs from all the accompanying species by the possession of tubercles, which seem always present, though they vary in number and distinctness.

Affinities.—It most nearly approaches *Capulus galeritus*, n. sp., which, however, is more depressed and narrower, and has a larger and more regular spiral, and also shows no tuberculation.

In the tuberculated variety of *Pileopsis prisca*, Goldf.,[1] the tuberculation is, as shown by numerous examples from the Eifel,[2] of a larger and more pronounced character, and the shell is more definitely coiled. From the smoother variety, which is described by Kayser,[3] it is more difficult to separate it, although the latter seems more flat and generally more definitely coiled, and its mouth is more oblique. The general appearance, however, of our specimens leads me to think that it must be distinct, and certainly none are in the slightest degree similar to typical Eifelian examples of that species.

13. CAPULUS GALERITUS, n. sp. Pl. XXII, figs. 3, 3 *a*, 4.

1834. BELLEROPHON, sp., *Steininger*. Mém. Soc. Géol. Fr., vol. i, pt. 2, p. 368, pl. xxii, figs. 3, 3 *a*, 3 *b*.

Description.—Shell rather large, depressed, rather narrow, elongate, loosely and elliptically coiled. Spire free, large, much recurved, consisting of more than a volution, sunk beneath the highest plane through the shell, but facing upwards. Apex very minute, apparently nearly approximate to the plane of the mouth. Body-whorl regularly increasing, subcircular or slightly oval in section, being most convex on the back, and somewhat flattened and produced below near the mouth; back very convex in the horizontal direction, but becoming less so near the mouth. Mouth not large, apparently oblique. Peristome sinuous.

Size.—Width 30 mm., depth 18 mm., height 17 mm.

Localities.—There is a specimen in the Museum of Practical Geology, and another in the British Museum from Wolborough; another in the Battersby

[1] 1844, Goldfuss, 'Petref. Germ.,' vol. iii, p. 9, pl. cxlviii, figs. 1 *b*—*d*.

[2] Ibid., pl. clxviii, fig. 1 *a*.

[3] 1878, Kayser, 'Abhandl. Geol. Specialk. Preuss.,' Band ii, pt. 4, p. 94, pl. xvi, fig. 5, and pl. xx, figs. 11, 14, 15.

Collection of the Torquay Museum probably from Wolborough; and two less perfect examples in my Collection, another small doubtful specimen in the Woodwardian Museum, and another in the British Museum, from Lummaton.

Remarks.—This species seems to stand about midway between *C. tylotus*, n. sp. and *C. invictus*, n. sp. From the former it is distinguished by its more regular spiral shape, less expanded mouth, and the absence of tubercles; and from the latter by its sunk and less perfect spire, and the absence of a defined spiral sulcus on the lower part of the whorl.

Affinities.—*Capulus substriatus*, Münster,[1] seems to approach this form. It appears to have a more perfect spire, to be more circular in section, and to be ornamented with spiral striæ, thus forming in some points a passage between the present species, *C. invictus*, n. sp. and *C. compressus*, Goldf.

Capulus neritoides, de Koninck,[2] from the Carboniferous, seems to have a small, but more developed spire than any of these species. It consists of more than two volutions.

Naticopsis obliqua, Trenkner,[3] as given by Clarke,[4] is a higher shell with a mouth more pronounced and angulated above, and a not-sinuous, round, thickened inner lip. It is, however, generally similar, and indicates that the present species is closely allied. In Trenkner's own figure the spire is larger, and there are regular distant longitudinal ridges. It is evidently not accurately drawn, but it shows, I think, that it clearly is a different species.

14. Capulus contortus, *F. A. Römer*, sp.? Pl. XXII, figs. 5—9.

1834.	Bellerophon ? sp., *Steininger*.	Mém. Soc. Géol. Fr., vol. i, pt. 2, p. 368, pl. xxiii, figs. 4, 4 *a*.
1841.	Acroculia vetusta, *Phillips* (pars).	Pal. Foss., p. 93, pl. xxxvi, fig. 169 *b* (only).
1844.	Pileopsis prisca, *Goldf.* (pars).	Petref. Germ., vol. iii, p. 9, pl. clxviii, figs. 1 *b* and *c* (only).
? 1843.	Acroculia contorta, *F. A. Römer*.	Harz., p. 26, pl. vii, figs. 1 *a*, *b*, 2 *a*, *b*.
1854.	Capulus vetustus, *Morris*.	Cat. Brit. Foss., p. 239.
? 1867.	— deflexus, *Trenkner*.	Paläont. Novit., p. 13, pl. i, fig. 24.
? 1884.	— vetustus, *Clarke*.	Neues Jahrb. f. Min., Beil.-Band iii, p. 362, pl. v, figs. 8, 9.

[1] 1840, Munster, pt. 3, p. 82, pl. xiv, fig. 29.

[2] 1842–4, de Koninck, 'Disc. An. Fossil.,' p. 334, pl. xxiii bis, figs. 1 *a*—*c*.

[3] 1867, Trenkner, 'Paläont. Nov.,' pt. 1, p. 12, pl. i, fig. 23.

[4] 1884, Clarke, 'Neues Jahrb. f. Min.,' Beil.-Band iii, p. 356, pl. v, figs. 6, 7.

Description.—Shell large, depressed, wide. Spire free (?), much incurved, tending slightly upwards, consisting of rather more than a volution. Apex unseen, but not far from the inner side of mouth. Body-whorl more or less subcircular in section, being flattened or slightly concave above, convex on the back, and more or less produced below, sometimes so as to form a concave wing; horizontally much arched, and divided by five or six indistinct and irregular spiral ridges and furrows, which give it a slightly angulated appearance. Mouth very large. Peristome deeply sinuous or undulating. Surface covered with fine, sharp, irregularly undulating striæ, crossed by occasional spiral inequalities.

Size.—Width about 45 mm., depth about 27 mm., height about 33 mm.

Localities.—From Wolborough there are two specimens in the Museum of Practical Geology, and three in Mr. Vicary's Collection. From Lummaton there are four specimens in my Collection, one in the Woodwardian Museum, and one in the Lee Collection in the British Museum.

Remarks.—Though as usual in this genus almost every specimen of the present species has a slightly different shape, there is a general resemblance in them which affords reason for grouping them together, and for distinguishing them from the adjoining species. Their most striking features are the indistinct horizontal furrows and ridges which are seen in very few of the other forms, while in the present species these are much less definite than in *C. multiplicatus*, Giebel. Other distinguishing points are the incurved and apparently free spire, slightly curving upward, but not distant from the plane of the mouth, and partly overhanging its inner margin; the boldly undulating peristome, and especially the expansion of the lower part of the body-whorl near the mouth, which thereby sometimes forms an area which is called by Phillips "a wing."

One of the specimens in the Museum of Practical Geology is the original of one of Phillips's figures of *Acroculia vetusta*, 'Pal. Foss.,' pl. xxxvi, fig. 169 *b*. As will be seen by the figure which I have given of it, Phillips's drawing does not quite represent its true shape. It is a somewhat flatter shell than our other specimens, and the "wing" is more extended; but it is quite possible from its appearance that it has been subjected to pressure, and to this cause the existence of the so-called "wing" may be partially due.

A comparison with Sowerby's original figure and with Carboniferous specimens of *Pileopsis vetusta*, Sow., in the Museum of Practical Geology, leads to the conclusion that our Devonshire fossil cannot belong to that species, which is a more limpet-shaped form with less arching whorls and smaller and less recurved spire. The two other figures given by Phillips in the 'Pal. Foss.' do not appear to belong to either of these species, but I have been unable to find the original specimen or specimens from which they were taken, and therefore it is difficult to feel certain on the point.

The figure of the furrowed variety of *Pileopsis prisca*, Goldf., is very similar, and perhaps represents the same species, though its furrows seem closer and more numerous. His name, however, cannot be retained for the present species, as it should be restricted to his tuberculated variety, which is quite distinct from the present form.

It is very similar to *Acroculia contorta* as described by F. A. Römer, which bears somewhat similar spiral ridges, and may perhaps be a small variety of the same species. Römer's figures are, however, not sufficiently distinct to enable us to be very certain about the identification.

Clarke states that Trenkner's *Capulus deflexus* is certainly the same as *A. vetusta*, Phil. (not Sow.), and from his mention of spiral furrows it would seem to belong to the part of his so-called species placed under the present head. Clarke's own figure, as well as Trenkner's, however, does not show any spiral grooves, and for that reason I was at first more inclined to place it with *C. tylotus*, n. sp., but the shape of the mouth accurately agrees with Phillips's type, Pl. XXII, fig. 6, of *Capulus contortus*, F. A. Römer (?), with which it is most likely identical.

Affinities.—*Capulus disjunctus*, Giebel,[1] is a closely allied species having similar spiral marks, but it is distinguished by its much longer and more definitely coiled spire, and its decidedly flatter shape.

Pileopsis sinuosa, F. A. Römer,[2] has a much smaller and less recurved spire, and is more flatly conical in shape.

Platyceras priscum, var. *undulatum*, Barrois,[3] has a straighter and longer body-whorl, and the spiral marks are gentle undulations rather than sharpish ridges.

15. Capulus multiplicatus, *Giebel*. Pl. XXII, figs. 10, 10 *a*, 11, 11 *a*.

1855. Acroculia haliotis, *F. A. Römer*. Beitr., pt. 3, p. 118, pl. xvi, fig. 8.
1858. Capulus haliotis, *Giebel*. Sil. Faun. Unterharz., p. 22, pl. iii, fig. 5.
1858. — multiplicatus, *Giebel*. Ibid., p. 23, pl. iii, fig. 6.
1878. — — *Kayser*. Abhandl. Geol. Specialk. Preuss., Band ii, pt. 4, p. 97, pl. xvi, figs. 7—9.
1889. Acroculia multiplicata, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 30.

Description.—Shell large, depressed, wide, angulated. Spire very small, recurved, tending slightly upwards, much depressed below the highest plane of

[1] 1858, Giebel, 'Sil. Faun. Unterharz.,' p. 25, pl. iii, fig. 4; and 1878, Kayser, 'Abhandl. Geol. Specialk. Preuss.,' Band ii, pt. 4, p. 95, pl. xvi, figs. 6, 6 *a*.

[2] 1850, F. A. Römer, 'Beitr.,' pt. 1, p. 33, pl. v, fig. 6.

[3] 1882, Barrois, 'Mém. Soc. Géol. Nord.,' vol. ii, No. 1, p. 281, pl. xiii, figs. 3 *a*, *b*.

the shell, consisting of less than a volution, probably free. Apex minute, very distant from the plane of the mouth. Body-whorl large, regularly increasing; in section subcircular, but much complicated by nine or ten large, deep, subangular, irregular, spiral grooves and ridges, which vanish only on the upper part of the spire; in longitudinal direction hardly curved, and regularly increasing, but slightly more expanded at the mouth.

Size.—Width 35 mm., depth 30 mm., height about 32 mm.

Localities.—There is a very fine example in Mr. Vicary's Collection and a very poor one in the Museum of Practical Geology from Wolborough; as well as another imperfect specimen in my Collection from Lummaton.

Remarks.—The deep angulated furrows, the long straight body-whorl, and the minute apex immediately distinguish this species. In Mr. Vicary's specimen upon the inner or sutural side there first comes a fold following the line from the apex to the mouth; this is followed by a wide deep groove, then on the shoulder come two high subangular folds separated by an equally narrow furrow, and followed by two wide deep furrows, separated by a small low fold; next on the back come two high flattened folds separated by a small furrow; then a very broad low fold bounded on each side by a rather deep narrow furrow, and then on the lower part of the whorl two high narrow folds separated by a rather small furrow: the rest of the surface is hidden by the matrix. It is exactly like a specimen of *Capulus multiplicatus*, Giebel,[1] as figured by Kayser,[2] and with this the English fossils must clearly be identified.

Affinities.—Under the name of *Capulus canalifer*, Münster[3] describes a very large species with very similar markings. This appears to differ from ours in size and in having a much less quickly tapering and straighter tube, so that the mouth is smaller and much more distant from the apex. The spiral grooves also seem much deeper and much shorter. In spite, therefore, of the great variability in species of this genus, I do not think that these two forms could with any degree of probability be referred to the same species.

Capulus haliotis, Sowerby,[4] of the Wenlock Limestone, with which F. A. Römer identified it, has a very much larger and more spiral apex.

Capulus conicus, Trenkner,[5] is a more conical shell, and the apex is not at all recurved.

[1] 1858, Giebel, 'Sil. Foss. Unterharz.,' p. 22, pl. iii, fig. 6.

[2] 1878, Kayser, 'Abhandl. Geol. Specialk. Preuss.,' Band ii, pt. 4, p. 97, pl. xvi, fig. 7.

[3] 1840, Münster, 'Beitr.,' pt. 3, p. 82, pl. xiv, fig. 27.

[4] 1839, Sow. in 'Murch. Sil. Syst.,' p. 625, pl. xii, fig. 16.

[5] 1868, Trenkner, 'Paläont. Novit.,' pt. 2, p. 21, pl. vii, fig. 14.

2. *Sub-genus.*—Orthonychia, *Hall*, 1843.

This is a sub-genus of *Capulus*, which is to be distinguished by its rounded mouth, the entire absence of a spire, and the straight or only very slightly recurved apex, the perpendicular from which falls within the circle of the mouth.

It is rare in Devonshire, and I am only acquainted with three specimens representing two species, but on the Continent and in America it seems to be sufficiently abundant. It occurs in the Devonian and Carboniferous formations.

1. Orthonychia costata, *Barrois*. Pl. XXI, figs. 7, 7 *a*, 7 *b*.

1889. Platyceras costatum, *Barrois*. Faun. Calc. d'Ebray, p. 196, pl. xiii, figs. 5, 5 *a—c*.

Description.—Shell rather small, depressed, transversely conical or campanulate, without a spire. Apex gone, but apical region horizontally compressed, slightly bent upwards, situated slightly above the median horizontal line. Perpendicular from apex falling well within the margin of the mouth. Sides of the shell spreading out from near the apex to the mouth with a slightly convex curve, the greatest convexity being along the back or outer side. Mouth large, flat, broadly oval. Surface covered by irregular, microscopic, undulating growth-striæ and indistinct radiating lines, and also on the greater part of the marginal third of the shell by a few strong, distant, sharpish, radiating ridges, visible to the naked eye.

Size.—Width 21 mm., breadth from apex to mouth 15 mm., height 18 mm.

Locality.—There is a single specimen from Lummaton in Mr. Champernowne's Collection.

Remarks.—This species is distinguished by its simple cup-shaped form, by its radiating ridges, which seem to vanish in the peristome, and by the absence of any spire. The only other fossil at all like it from the localities now under review is *Orthonychia quadrangularis*, but that shell is sufficiently distinguished by its less elevated form and its almost flat surface.

Barrois's figured specimen has rather more numerous costæ than the English specimen, and its apex is slightly more distant from the mouth, and more central in respect to it, but on the whole there can be, I think, no doubt that it is identical.

2. ORTHONYCHIA QUADRANGULARIS, n. sp. Pl. XXI, figs. 8, 8 *a*, 8 *b*.

? 1878. CAPULUS ? sp., *Kayser*. Abhandl. Geol. Specialk. Preuss., Band ii, pt. 4, p. 98, pl. xvii, figs. 1, 1 *a*.

Description.—Shell large, rather elevated, conical or campanulate, without volutions. Apical extremity horizontally compressed, erect or very slightly recurved, gently bent upwards, not spiral. Apex itself accidentally removed in type specimen. Perpendicular from apex falling within the aperture, but very near its front. Mouth very large, oval or oblong, considerably wider than long. Margins sinuous, consisting of eight or nine double undulations, which are strongest at the front or outer part of the peristome. Shape of shell rather elongate at apex, then very rapidly expanding for about a third of its height, and there turning through a blunt elbow and proceeding in a slightly expanding cone to the aperture, gradually developing the undulations seen at the mouth. Surface covered with low, subsinuous, irregular growth-ridges, which are seen under a lens to be composed of very fine, discontinuous, fimbriated lines. Shell-structure extremely thin, almost papyraceous. Mould (?) marked on the back by numerous straight, definite, longitudinal ridges, and a few concentric bulges, corresponding with the chief growth-lines of the shell.

Size.—Height from apex 21 (probably 22) mm., length of mouth 28 mm., width of mouth 38 mm.

Localities.—There is a fine specimen in the Torquay Museum, which may have come from Wolborough; and a smaller specimen in my Collection, which came from Lummaton.

Remarks.—This fine shell seems to be distinguished by its untwisted elevated apex, gently undulating surface, and peculiar bell-shaped form.

Affinities.—This species comes very near to *Platyceras* (*Orthonychia*) *conicum*, Hall.[1] That shell seems to be extremely variable, but differences may be observed in the greater flatness and convexity, and in the more lateral position of the apex of the English form.

It comes very near to *Orthonychia costata*, Barrois, with which at first I regarded it as identical, but the presence on the latter of a number of sharp, radiating ridges seems to indicate that they are specifically distinct.

In *Capulus hercynicus*, Kayser,[2] the perpendicular from the apex to the plane of the mouth is very much longer, and, except in the varieties where it is longest,

[1] 1879, Hall, 'Pal. N. Y.,' vol. v, pt. 2, p. 3, pl. i, figs. 13—23.

[2] 1878, Kayser, 'Abhandl. Geol. Specialk. Preuss.,' Band ii, pt. 4, p. 89, pl. xiv, figs. 1—14.

falls in the centre of the aperture. Kayser unites with his shell several species of F. A. Römer and Giebel, all differing from the present shell in this particular.

VI. *Family.*—Scalaridæ, *Chenu.*

1. *Genus.*—Holopella, *M'Coy*, 1852.

The shells of this genus are very elevated, with very numerous narrow whorls, and with very fine longitudinal and also sometimes spiral striæ. The surface has often a polished or glossy appearance. It extends from the Silurian to the Trias.

1. Holopella tenuireticulata, n. sp. Pl. XVIII, figs. 9, 9 *a*, 9 *b*.

Description.—Shell of moderate size, very elongate, spiral, tapering regularly, many-whorled. Sutural angle varying. Suture small, shallow, rather wide. Whorls increasing regularly, short, being about half their diameter in height, slightly convex, sloping flatly from the upper suture, and becoming suddenly more convex at their posterior end so as to slightly overhang the lower suture; ornamented by multitudinous, fine, sharp, rather irregular striæ, sloping straightly and obliquely backwards from the upper suture over the greatest part of the whorl, but curving rather more forwards in its lower region, and imbricated by equally numerous, rounded, spiral threads, so as to form a very fine lozenge-shaped reticulation. Body-whorl small, curving suddenly in its lower part, and continued flatly and obliquely inwards to form the base, which is marked only by spiral threads, as the perpendicular lines have in that part almost entirely disappeared. Mouth ovate. Columella straight. Shell-structure thin.

Size.—Height (of three and a half whorls) 30 mm., width 12 mm.

Locality.—Wolborough. A single example is in Mr. Vicary's Collection.

Remarks.—This shell appears to be distinguished by the exceeding fineness of its ornamentation, by its very elongate form, and by its narrow whorls. The sharp perpendicular lines are broken into a series of frills by the imbrication of the spiral threads. The spire appears to taper regularly as far as is shown by the portion remaining in Mr. Vicary's specimen, and if this were continued throughout it would indicate a shell between 70 and 80 mm. high, but most probably the rate of tapering increased apically, so that the shell would be somewhat shorter. The sutural angle is very variable, so that the lines of the

sutures appear when viewed on one side almost horizontal, and when viewed in the opposite direction exceedingly oblique. The shape of the aperture cannot be properly made out as its lower part is broken away, but there are signs of a strong columella or rounded inner lip.

Affinities.—In *Holopella Hennahiana*, Sowerby, the whorls are more convex, the transverse striæ coarser, the sutures larger, and there are no spiral threads.

2. HOLOPELLA TENUISULCATA, *Sandberger*. Pl. XVII, figs. 20, 20 *a*; and Pl. XVIII, figs. 10, 10 *a*, 11.

1853.	HOLOPELLA TENUISULCATA, *Sandberger*.	Verst. Rhein. Nassau, p. 229, pl. xxvi, fig. 6.
1860.	— ELONGATA, *Eichwald*.	Lethæa Rossica, p. 1123, pl. xliii, fig. 9.
1889.	— TENUISULCATA, *Whidborne*.	Geol. Mag., dec. 3, vol. vi, p. 30.

Description.—Shell of moderate size, elongate, spiral, of many whorls. Sutural angle large, probably variable. Suture rather deep. Whorls broad, about two-thirds their diameter in height, numerous, probably eight or nine, moderately convex, becoming suddenly steeper at the lower end, so as slightly to overhang the suture. Ornament consisting of very numerous, fine, transverse, very irregular, subacute striæ, which sometimes appear and vanish indiscriminately, and are very unequal in size, and which are reticulated or crenulated by very indistinct and still closer spiral lines, so as to give them the appearance of frills. Base of shell rounding gently in, nearly smooth. Aperture small, broadly ovate, pointed above, rounded below. Columella short, arched, involute at the extremity. Outer lip sharp, moderately convex, slightly expanded along its edge. Shell-structure thin.

Size.—A specimen consisting of the five lower whorls is 34 mm. high and 14 mm. in diameter.

Locality.—From Wolborough there are two good specimens and a poor cast in Mr. Vicary's Collection; another, which is very poor, but appears to belong to the same species, in the Museum of Practical Geology, and a cast which is scarcely identifiable, but which is similar in shape, in the Torquay Museum. From Lummaton there is a specimen in the Woodwardian Museum.

Remarks.—Upon the penultimate whorl of the Woodwardian specimen is a broad band formed by two parallel brown-stained lines. This mark seems rather perplexing, for although it is in a natural position upon the whorl it is hard to say

what it indicates, and there is no sign of a similar mark on any of the other whorls. It is possible that it may be the remains of a colour-band.

The present species seems to be distinguished by its slender shape and the great breadth of its whorls.

H. elongata, Eichwald, corresponds exactly in shape, and is in all probability the same species, though its ornament seems to have been rather more indistinct.

Affinities.—It approaches most nearly to *H. tenuireticulata*, fig. 9, from which it is distinguished by its much less elongate form, by the direction of the striæ, and by the much greater coarseness of its ornamentation. In spite of these differences it bears so great a general likeness to that shell that I am in considerable doubt whether to regard it as a distinct species or only as a variety of it. It is clearly distinguished from *H. duplisulcata* by its less conical form, and by the different character of its ornamentation; and from *H. costata*, Sandberger, by its broader whorls and less conical form.

Mr. Vicary's specimen was labelled by Salter "*Loxonema Hennahiana*," Sow. sp., but Sowerby's figure of his *Terebra Hennahiana*[1] shows that his shell is distinguished by having narrower whorls, and coarser, more direct, and straight striæ, as seen in our figure, Pl. XVIII, fig. 16, of that shell.

Turritella tenuicarinata, Münster,[2] differs in having a slight keel immediately below the suture, and in being otherwise smooth.

Melania absoluta, Goldfuss,[3] has decidedly higher whorls and more direct striæ.

Loxonema læve, F. A. Römer,[4] is very similar, but its spire is longer and its surface is smooth. Clarke,[5] moreover, states that it has varices.

Holopella elegans, Eichwald,[6] is almost identical in shape, but it is distinguished by possessing fine spiral, and no longitudinal lineations.

[1] 1840, Sow., 'Geol. Trans.,' ser. 2, vol. v, pt. 3, pl. lvii, fig. 22.
[2] 1840, Münster, 'Beitr.,' pt. 3, p. 89, pl. xv, figs. 20 *a*, *b*.
[3] 1844, Goldfuss, 'Petref. Germ.,' vol. iii, p. 110, pl. cxcvii, fig. 13.
[4] 1850, F. A. Römer, 'Beitr.,' pt. 1, p. 35, pl. v, fig. 11.
[5] 1883, Clarke, 'Neues Jahrb. f. Min.,' Beil.-Band iii, p. 365, pl. v, fig. 21.
[6] 1860, Eichwald, 'Lethæa Rossica,' p. 1634, pl. xliv, fig. 25.

Turritella Koninckiana, Goldfuss,[1] comes very close to it, but differs in being decidedly more elongate, and in having flatter, shorter, and more numerous whorls, and a more uniform striation. It is from the Carboniferous beds of Ratingen.

Semenow and Möller[2] figure as *Turritella spiculum*, Eichwald,[3] a minute species which agrees with the present form in general shape, but it is quite impossible to judge from their drawing whether its ornamentation is the same or not. Eichwald's own description, however, shows that it possessed spiral, instead of transverse, striæ.

4. Holopella Hennahiana, *Sowerby*, sp. Pl. XVIII, figs. 16, 16 *a*.

1840. Terebra Hennahiana, *Sowerby*. Geol. Trans., ser. 2, vol. v, pt. 3, pl. lvii, figs. 22, 22 *a*.
1841. Loxonema Hennahiana, *Phillips*. Pal. Foss., p. 99, pl. xxxviii, fig. 184.
1844. Melania antiqua, *Goldfuss*. Petref. Germ., vol. iii, p. 110, pl. cxcvii, fig. 14.
1845. Terebra Hennahii, *Sow.* Encyclop. Metrop. (*fide* Sowerby, Geol. Trans.).[4]
? 1853. Holopella tenuicostata, *Sandberger*. Verst. Rhein. Nassau, p. 228, pl. xxvi, figs. 7, 7 *a*.
1854. Loxonema Hennahiana, *Morris*. Cat. Brit. Foss., p. 255.
? 1882. Holopella tenuicostata, *Holzapfel*. Palæontogr., vol. xxviii, p. 249.
1888. Loxonema Hennahiana, *Etheridge*. Foss. Brit., vol. i, Pal., p. 163.
1889. Holopella tenuicostata, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 30.

Description.—Shell small, elongate, spiral, conical, acuminate, of many whorls. Sutural angle slightly varying. Suture small, shallow. Whorls six or seven, narrow, moderately convex, the convexity seeming to be rather less in the middle of the whorl. Ornament consisting of numerous fine, distant, regular, nearly straight, sharp lines, barely visible to the naked eye, and set perpendicularly to the suture. Columella arched (?). Inner lip diffuse, callous.

Size.—Height 24 mm., width 15 mm.

Locality.—Lummaton. There are two specimens in the Battersby Collection in the Torquay Museum. Sowerby records it from Plymouth.

Remarks.—I have not met with Sowerby's type of this species; but, as far as

[1] 1844, Goldf., 'Petref. Germ.,' vol. iii, p. 104, pl. cxcvi, figs. 5 *a*—*c*.

[2] 1863, Semenow and Möller, 'Ober-Dev. Schicht. des Mittl. Russ.,' p. 674, pl. iv, fig. 10.

[3] 1860, Eichwald, 'Lethæa Rossica,' p. 1120, pl. xlii, fig. 5.

[4] This article appears to have been written by Sowerby before that in the 'Geol. Trans.,' although not published till 1845.

Locality.—Wolborough. There is a finely preserved specimen in the Museum of Practical Geology, in which, however, the aperture is hidden; and a poor specimen in Mr. Vicary's Collection.

Remarks.—This shell comes very close to Sandberger's figure of his species *H. tenuisulcata*, Sandberger. It differs, however, from that, and from the English shell with which I identify that German species, in being a much more conical shell, and in having much narrower whorls and coarser ornamentation. Though I was at first inclined to identify it with that shell, it appears to me that the differences are so strongly marked that it must certainly be kept distinct.

It appears, however, to correspond with another species figured by Sandberger, viz. *Loxonema costatum*, Goldfuss, MS., except that the lineations are considerably finer than those in one of his figures. He, however, describes that as a coarsely ribbed variety, and his other figure shows the lineations to be almost as fine as those of ours. Hence it may be regarded as the same species. He, however, identifies it with *H. Hennahiana*, Sow., from which it is quite distinct, and also with *Melania Kaupii*, Goldfuss,[1] which appears to be a totally different form with strong direct ribs and transverse striæ.

Affinities.—This species is very much the shape of *H. duplisulcata*, but differs, as shown above, in the character of its ornamentation.

2. *Genus.*—Scoliostoma, *Braun*, 1838.

The shells of this genus are more or less spirally conical, and consist of a nearly circular tube loosely coiled upon itself for the greater part of its length. Their distinctive feature is the sudden deflexion of the body-whorl, which, leaving the regular coiling, is twisted back asymmetrically, so that the mouth sometimes appears midway up the spire, or even above the apex. The peristome is nearly circular, complete, and sometimes thickened. The shell is reticulate and slightly umbilicated. The genus appears to be confined to the Devonian beds.

The genus *Strophostoma*, Deshayes, which is referred to the fresh-water family *Cyclostomidæ*, bears very great resemblance to it, especially in the asymmetrical deflexion of the aperture. This genus existed from the Chalk to the Miocene epoch.

[1] 1844, Goldfuss, 'Petref. Germ.,' vol. iii, p. 110, pl. cxcvii, figs. 15 *a*, *b*.

the specimens in the Torquay Museum is interesting, as, though only 3 mm. high, it contains parts of the nucleus and four whorls. It seems decidedly a narrower and more elevated shell than any of the other specimens,—so much so, indeed, that I am in doubt whether it will prove to belong to this species; but, as the ornament is exactly the same, and the specimen is not sufficiently perfect for us to be certain of its true shape, it seems better to leave it for the present under this heading. With some of the other specimens it shows that the shell was acuminate at least in the young stage.

Phillips refers this species to the genus *Turbo*. But, though he does not mention the remarkable retroflexion of the body-whorl, he shows it clearly in his figure, which thus proves that it cannot be a "Turbo." His type specimen has not yet been recognised.

Münster's own figure represents a small shell with markings similar to those of our specimens, but it does not show the peculiar twist of the body-whorl, and ends just like an ordinary Gasteropod. This might very well be accounted for by supposing the specimen to be imperfect, or to have been too young to have developed the peculiar mouth; so that there is no reason for questioning the correctness of Phillips's identification in this case.

It also appears from Sandberger's description and figure to be the same shell as his *Scoliostoma megastoma*, the only difference being (if we understand his fig. 2 *b* aright) that the concentric ridges are only visible on the back of the body-whorl, and not on its upper and lower sides. Of this, however, he says nothing in the letterpress, and it is so slight a distinction that, even if it is not a mere slip of the draughtsman, it is altogether too small a thing to be counted more than an accidental individuality. He also speaks of a slight carina close to the suture, but I can see no trace of it either in the English specimens or in his own figures.

Neither can I see any distinction of specific value between it and *Sc. crassilabrum*. If the distinction be that *Sc. crassilabrum*, Sandberger, has wider furrows than *Sc. megastoma*, then the former comes nearer the English form in that respect than the latter. If it be, on the other hand, in the greater convexity of its whorls, it is, I think, clear from the English specimens that this character varies considerably; and, indeed, the spire is of such an elementary nature that considerable variation in it might be expected. I have therefore added this name also to the list of synonyms.

Sandberger separates the *Turbo texatus*, Phil., from that of Münster, and refers it to the genus *Scoliostoma*, but he did not recognise it from its drawing as the shell he was describing. We have already seen that the difference in Münster's shell is probably only due to its immature condition.

Turbo cyclostomoides, F. A. Römer, seems identical, except that it wants the twisted lower whorl. Römer describes the aperture as "angulated circular,"

and it appears to me that this is the shape it would assume if the true mouth were absent.

2. SCOLIOSTOMA GRACILE, *Sandberger* (?). Pl. XXIII, figs. 10, 10 *a*.

? 1853. SCOLIOSTOMA GRACILE, *Sandberger*. Verst. Rhein. Nassau, p. 225, pl. xxvi, figs. 5, 5 *a*.
1889. — — *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 30.

Description.—Shell small, very elongate, turriculated, many-whorled. Spire of more than ten whorls, conical below, but becoming almost cylindrical towards the apex. Suture apparently rather deep. Whorls narrow, about half their diameter in height, but increasing in height with their proximity to the apex; moderately convex, the convexity slightly increasing in the lower part of the whorl; slightly angulated along the median line. Ornamentation mammillar, consisting apparently of small rounded tubercles arranged in six spiral rows, the first of which is immediately below the suture, and seems more continuous than the rest. Body-whorl uniform with the whorls above, and turning in suddenly to form an almost flat base. Umbilicus minute and deep. Columella or inner lip rounded, thickened, and expanded.

Size.—Height of a specimen retaining the ten lower whorls 19 mm., width 7 mm.

Locality.—Wolborough. A single example is in the Battersby Collection in the Torquay Museum.

Remarks.—The specimen from which the above description is taken has its surface very much worn and blurred, after the characteristic manner of so many of the Wolborough shells, so that it is impossible to decipher the ornamentation with any degree of certainty. Its mouth, also, is a good deal injured and obscured by the matrix, but it would seem to have been of a more or less rounded and expanded form, with a thickened peristome. The top of the spire is so nearly cylindrical as probably to indicate that several upper whorls are absent, but it becomes more conical downwards, and in consequence of this the comparative narrowness of the whorls increases with their distance from the apex.

A comparison of this specimen with the figure of *Scoliostoma gracile*, Sandberger, leads me to the conclusion, in which Mr. Roberts supports me, that, as far as the present evidence goes, they are probably to be referred to the same species. There are certainly some differences between them, especially in the greater narrowness of the whorls of the German shell and in its more conical form, but

as it has the same tendency to the upward elongation of the spire, and is a larger specimen, it seems most probable that these differences are to be explained by age. The ornamentation in the English shell is too obscure to be compared with that of the German shell with certainty, but it seems to be much in the same nature, except that the latter shows no signs of median angulation.

Affinities.—Turritella cancellata, Goldfuss,[1] has similar, but twice as fine, ornamentation. It seems very nearly to correspond in general shape, but Goldfuss's figure gives no points for generic comparison.

Achrisina multicristata, Œhlert,[2] differs in having narrower whorls, and in being only ornamented with definite, and probably more numerous, spiral lines, whereas there is little doubt that the English shell was more or less tuberculous. Though the base of the French shell is gone, it is sufficiently like the English shell in general form to show that it very probably may belong to the same genus.

3. *Genus.*—Antitrochus, gen. nov.

Shell spiral, turbiniform, sinistral, of few loosely coiled and almost wholly exposed, convex whorls. Sutures large, wide, and deep. Mouth subcircular or subquadrate. Peristome continuous. Umbilicus minute. Ornamentation consisting of both spiral and longitudinal threads.

In this genus I would place the shell described below, and also *Scalaria antiqua*, Münster. I have been unable to find any known genus to which these shells might be satisfactorily referred, nor have several palæontologists whom I have consulted on the question been able to recognise their generic position. They appear to bear so strong a general likeness to many of the *Scalaridæ* that I have no hesitation in referring them to that family; but to the genus *Scalaria* they clearly, in the opinion of Mr. Etheridge, F.R.S., and others, do not belong. They approach the genus *Scoliostoma*, but from that they are separated by the absence of any irregularity in the body-whorl, and other points.

In both the above-named species the shells are sinistral, but it may be unsafe to regard this as a generic quality until a larger number of species are known, as others may be found which agree in every other quality, but have dextral shells.

[1] 1844, Goldfuss, 'Petref. Germ.,' vol. iii, p. 103, pl. cxcvi, figs. 10 *a*, *b*.

[2] 1887, Œhlert, 'Bull. Soc. d'Étud. Sci. d'Angers,' p. 10, pl. viii, figs. 4, 4 *a*.

1. ANTITROCHUS ARIETINUS, n. sp. Pl. XXIII, figs. 11—13.

1841. PLEUROTOMARIA ANTITORQUATA, *Phillips* (pars). Pal. Foss., p. 96.
1854. VERMETUS ANTITORQUATUS, *Morris* (pars). Cat. Brit. Foss., p. 285.
1889. SCALARIA ANTIQUA, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 30 (not Münster).

Description.—Shell spiral, moderate in size, sinistral, pyramidical, turbiniform. Spire containing about four regularly and rapidly increasing whorls. Suture very deep, narrow, and horizontal. Sutural angle varying, so that on one side the whorls are horizontal, and on the other very oblique. Whorls very convex, being circular or short-elliptic in section. Ornament reticulate, consisting of about eighteen or twenty rounded, distant, rather unequal, and occasionally slightly undulating spiral lines on the body-whorl (including the base), of which more than half are visible on the upper whorls; crossed by finer, straight, longitudinal lines, sloping obliquely backwards from the suture. Umbilicus apparently minute, and twisted. Mouth rounded or subquadrate, slightly angulated below. Inner lip thickened, elevated, recurved on itself.

Size.—Height 18 mm., width 16 mm.

Localities.—There are four specimens in the Godwin-Austen Collection in the Museum of Practical Geology from Wolborough; and another specimen in the Battersby Collection in the Torquay Museum, which appears to have come from Lummaton or Barton.

Remarks.—These shells at first sight appear to agree with *Pleurotomaria antitorquata*, Phillips,[1] but they differ in the important particular of the total absence of a sinus-band or any deflexion of the longitudinal striæ. Those points are very clearly denoted in the enlarged figure which Phillips gives of his shell, as well as in a specimen in the Godwin-Austen Collection, which may have been his type; and therefore we are forced to believe that the present fossils belong not only to a different species, but also to a different genus. Again, in *Schizostoma antitorquatum*, Münster,[2] with which Phillips identifies his shell as well as in the kindred *Schizostoma contrarium*, Münster,[3] the presence of a sinus-band situated on the lower part of the whorl is clearly seen; and therefore it cannot be united to either of these species. At the same time Phillips, while figuring under the name of *Pl. antitorquata* a shell from South Petherwyn, refers to some specimens, belonging to Mr. Godwin-Austen, from Newton. As the present are the only

[1] 1841, Phillips, 'Pal. Foss.,' p. 96, pl. xxxvii, figs. 176 *d*, *e*.
[2] 1840, Münster, 'Beitr.,' pt. 3, p. 87, pl. xv, fig. 12.
[3] Ibid., p. 87, pl. xv, fig. 13.

specimens which are at all similar to them in the Godwin-Austen Collection, it seems most probable that they must be those referred to; and, therefore, it appears that Phillips must have overlooked their difference from his South Petherwyn type.

All the above-mentioned five specimens are sinistral, and evidently belong to one species, but at the same time they show slight variations in the coarseness of the ornament. The longitudinal lines are sometimes much closer than the spiral, and sometimes equally distant. The spiral lines also seem to vary in number, though apparently they are usually much fewer than those in *Pl. antitorquata*, Phillips. The intersections of the lines form nodes, so that the structure of the shell is moniliferous. One of the Godwin-Austen specimens shows a curious irregularity of growth; the shell has apparently been fractured and mended while alive, and hence a second set of spiral lines arise near the mouth at an acute angle to the original ridges.

Affinities.—This species so nearly approaches *Scalaria antiqua*, Münster[1] (referred by d'Orbigny to *Turbo*[2]), as evidently to belong to the same genus, but differs from it in being a much wider shell with a less compressed body-whorl and aperture, in having its longitudinal lines oblique instead of perpendicular to the spiral markings, and in its ornamentation being much coarser. Thus, if Münster's figure is accurate, it cannot be regarded as the same species.

It differs from *Scoliostoma texatum*, Phillips sp., in having no twisting of the mouth, in being a much wider shell, and in having its ornamentation coarser and reticulate instead of cancellate or decussate.

VII. *Family.*—Solaridæ, *Chenu.*

1. *Genus.*—Philoxene, *Kayser*, 1889.

Shell spiral, discoid, or conical, of rather numerous volutions, rather loosely coiled, so that the whorls hardly do more than touch at the suture. Suture deep and wide. Umbilicus large, deep, and wide, perforating the spire almost to the apex. Surface chiefly ornamented by growth-lines, but frequently bearing rows of scars from the agglutination of shell-fragments or foreign bodies. Shell-structure somewhat massive.

This genus was established by Professor Kayser in consequence of his having discovered marks of agglutinated shells upon some examples of *Euomphalus laevis*, d'Arch. and de Vern. He defines it as wanting the conical shape, sharp rim, and concave base of *Xenophora*, Fischer von Waldheim, 1807 (= *Phorus*, Montfort,

[1] 1838. Münster. 'Beitr.' pt. 1. p. 61. pl. xii. fig. 1.

[2] 1847. d'Orbigny. 'Prodrome.' p. 66.

1. PHILOXENE PHILOSOPHUS, *Whidborne* sp. Pl. XXIII, figs. 14—17.

1889. PHORUS PHILOSOPHUS, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 30.

Description.—Shell large, subangular, forming a low spiral of few and rapidly increasing whorls. Suture angular, wide, and deep. Whorls very convex, starting horizontally from the suture, then turning through a blunt elbow, and running for about the same distance obliquely towards the widest part of the whorl, where they turn with a circular curvature to the front of the shell, when the curvature becomes less, but increases again as it traverses the inner side of the whorl, which forms the umbilicus. Mouth entire, of moderate size, transversely oval and dilate. Umbilicus extremely large and deep. Surface marked with indistinct and irregular, coarse, undulating plaits or growth-lines, and bearing on the lower or widest part frequent irregular hollows, which occasionally preserve fragments of univalves or other shells adhering, or show their casts. Shell-structure very thick.

Size.—Height 38 mm., breadth 52 mm., width 40 mm. A second specimen measures respectively 22, 38, and 34 mm.

Localities.—Chudleigh, Lummaton, Wolborough. There are six specimens of this remarkable shell in Mr. Vicary's Collection from Chudleigh, one of which is very large, but none are in a very good state of preservation. In the same collection are two or three indistinct specimens from Wolborough. There are seven poor and small specimens in the Torquay Museum, two of which came from Wolborough, and possibly the other five from Lummaton. There is one small specimen from Wolborough in the Museum of Practical Geology. In my own collection is another specimen from Lummaton.

Remarks.—It is interesting to find shells with this peculiar habit in so old a formation as the Devonian, but the specimens in Mr. Vicary's Collection leave no doubt about the fact. Although much injured by the effects of fossilization his largest specimen in particular shows several fragments of agglutinated shells, as well as the impression of several whorls of a small univalve, which is almost sufficiently distinct to be specifically determined. The specimen in my collection was found and given to me by my friend Professor Hughes during a recent visit with me to Lummaton. Being small and indistinct, we did not recognise it at the time; but, on examining it afterwards, I found that the dents, which we at first supposed to be accidental, were really the remains of the agglutinations characteristic of the genus. It is to be observed that these adherences are primarily along the line of the extreme convexity of the whorls, and therefore are, in the

upper whorls, merged in their lower sutures. It is probable that this position was that which most required guarding or obscuring in shells of such a shape. The shell-structure is, however, so massive in this species (unlike that of *Xenophora agglutinans*, Lamarck, of the Eocene, and recent forms) that the foreign material could hardly have been attached for the purpose of strengthening the shell itself, though it may have been of use in preserving the animal from jars.

Affinities.—The first described Devonian agglutinating shell, *Phorus Bouchardii*, E. Deslongchamps,[1] from the Boulonnais, is very similar to the English species, but not, I think, identical. Its size is much less than our larger specimens. It is less massive, the suture is much less deep, so that it is much more trochiform in shape, and it bears a low spiral ridge or flattened band midway down the whorl, which, however, is not the widest part, as it would have been in the English species if it had existed there. Thus it differs specifically from our form, but is generically very similar, the chief distinctions in that point of view being its more trochiform shape and smaller umbilicus. Whether these distinctions are sufficient may be questioned. If they are, it brings Kayser's genus *Philoxene* much nearer to *Xenophora*.

Onustus (*Pseudophorus*) *antiquus*, Meek, from the Devonian of America, does not carry adherent particles upon its shell.

2. PHILOXENE LÆVIS, *d'Archiac* and *de Verneuil*. Pl. XXIII, figs. 18, 18 *a*, 19.

1842.	EUOMPHALUS LÆVIS, *d'Arch.* and *de Vern.*	Geol. Trans., ser. 2, vol. vi, pt. 2, p. 363, pl. xxxiii, figs. 8, 8 *a*.
1842.	— PLANORBIS, *d'Arch.* and *de Vern.*	Ibid., p. 363, pl. xxxiii, figs. 7, 7 *a*.
1842–4.	— — *de Koninck.*	Desc. Anim. Foss., p. 434, pl. xxv, figs. 7 *a*, *b*.
1843.	— OMALOCEPHALUS, *d'Omal.*	Précis Élém. Géol., p. 517.
1844.	— PLANORBIS, *Goldfuss.*	Petref. Germ., vol. iii, p. 82, pl. clxxxix, fig. 8.
1848.	— — *Bronn.*	Index Palæontologicus, p. 481.
1853.	— LÆVIS, *Sandberger.*	Verst. Rhein. Nassau, p. 213, pl. xxv, figs. 6, 6 *a*, 6 *b* (not fig. 7).
1882.	— — *Holzapfel.*	Palæontographica, vol. xxviii, p. 251.
1884.	— PLANORBIS, *Clarke.*	Neues Jahrb. f. Min., Beil.-Band iii, p. 359.

[1] 1862, E. Deslongchamps, 'Bull. Soc. Lin. Norm.,' vol. vi, p. 151, pl. viii, figs. 1—4.

?1887. Euomphalus, cf. planorbis, *Tschernyschew*. Mém. Com. Géol. Russ., vol. iii, No. 3, p. 171, pl. vi, figs. 5 *a—c*.
1888. — planorbis, *Etheridge*. Foss. Brit., vol. i, Pal., p. 163.
1889. — — *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 30.
1889. Philoxene lævis, *Kayser*. Zeitschr. Deutsch. Geol. Gesell., p. 292, pl. xiii, figs. 5, 5 *a—c*.

Description.—Shell rather large, discoidal, flat, of four or five whorls. Spire flat, the upper surface of the central whorls lying in one plane, but that of the outer whorls tending more or less to become conical. Suture deep, vertical. Whorls slowly increasing; in section nearly circular, rising from the suture, slightly elevated or subangulated at the shoulder so as to form a clear though indefinite elbow; marked by fine, irregular, indistinct growth-lines. Shell-structure rather thin, thickened at the shoulder. Umbilicus very large.

Size.—Height 6 mm., width 20 mm.

Localities.—From Wolborough there are two specimens in the Godwin-Austen Collection in the Museum of Practical Geology, one in Mr Vicary's Collection, and one in the Torquay Museum. From Lummaton there is a specimen in my Collection, and two others in the Torquay Museum are probably from the same place.

Remarks.—In 1842 d'Archiac and de Verneuil described simultaneously two shells, *Eu. lævis* and *Eu. planorbis*. The former of these exactly corresponds with our figured English specimen. The other differs in several slight particulars, but it seems to be the impression of Dr. Kayser, following Bronn, that these differences are not of specific value, and he unites them into one species under the name *Ph. lævis*. This view a comparison of the figures of the two species leads me to consider perfectly correct; the more so as we frequently find a considerable amount of individual variation in other kindred species.

There seems little reason for giving preference to either name. Its describers place *Eu. lævis* before *Eu. planorbis*. The former they identify in their "Tabular List," though not in their description, with *Eu. lævis*, Goldfuss, a catalogue name for a shell which Goldfuss afterwards figured as *Eu. serpens*, Phillips, with which it agrees. Bronn doubtfully unites them under the name *Eu. planorbis*. Other authors have used the two names nearly equally. On the whole it seems best to follow its describers in giving priority to *Eu. lævis*.

Dr. Kayser formed his new genus for the reception of this shell because he had observed that one or two German examples of it retained agglutinated fragments of foreign shells. The same feature is occasionally to be observed, though to a much slighter degree, in the English shells, and forms an additional reason for concluding not only the generic but specific identity.

The shell described by de Koninck under the name of *Eu. planorbis* from the Carboniferous of Belgium differs so slightly that we may regard it as identical.

Affinities.—From *Eu. circularis* and *Eu. Hecale* this species differs by the slow rate of increase of its whorls.

From *Eu. serpens* it is distinguished by its spire being flat or slightly elevated instead of being sunken, and by the distinct elbow upon the upper part of the whorls.

In some of the specimens the last whorl suddenly changes its horizontal direction so as to give the shell the form of a truncated cone. Thus it differs from the conical species *Eu. Dionysius* and *Ph. philosophus* not only by the slower rate of increase of its whorls, but by the cone of its spire being truncated.

Euomphalus papyraceus, F. A. Römer,[1] appears to have a papyraceous test and still more slowly increasing whorls, and to lie in one plane.

Porcellia lævigata, Léveillé,[2] appears very similar to the specimen figured on Pl. XXIII, fig. 19, but differs in the spire being almost equally concave with the umbilicus, and in the flat and lozenge-shaped section of the whorls—points which, in all probability, may be taken to be sufficient to prove that that Carboniferous shell is distinct.

3. PHILOXENE SERPENS, *Phillips* sp. Pl. XXIV, figs. 1—5.

1841.	EUOMPHALUS SERPENS, *Phillips* (pars).	Pal. Foss., p. 94, pl. xxxvi, fig. 172 (*a* and *b* only).
1844.	— — *Goldf.*	Petref. Germ., vol. iii, p. 88, pl. cxci, figs. 8 *a*, *b* (Carboniferous).
1850.	— PLANORBIS, *F. A. Römer.*	Beitr., pt. 1, p. 37, pl. v, figs. 24 *a*, *b*.
1854.	— SERPENS, *Morris.*	Cat. Brit. Foss., p. 248.
1860.	— ORBIS, *Eichwald.*	Lethæa Rossica, p. 1155, pl. xlii, figs. 8 *a*, *b*.
1861.	— CLYMENOIDES, *Hall.*	Desc. N. Sp. Foss., p. 26.
1862.	— — —	Fifteenth Rep. N. Y. State Cab. Nat. Hist., pp. 54 and 166, pl. vi, figs. 1, 2.
1876.	— — —	Pal. N. Y., vol. v, pt. 2, p. 62, pl. xvi, fig. 15; and pl. lxx, figs. 1—5.
1888.	— SERPENS, *Eth.*	Foss. Brit., vol. i, Pal., p. 163.

Description.—Shell rather small, discoid, very flat, of about five rather slowly increasing volutions. Spire usually elliptically coiled, flatly concave, slightly less so than the umbilicus. Suture deep and very well defined, facing upwards. Whorls almost circular in section, attached to the whorl within by a very narrow portion, so that the shell is hardly involute. Back slightly oblique. Surface

[1] 1850, F. A. Römer, 'Beitr. Harz.,' pt. 1, p. 49, pl. viii, fig. 7.

[2] 1835, Léveillé, 'Mém. Soc. Géol. Fr.,' vol. ii, pt. 1, p. 39, pl. ii, figs. 12, 13.

crossed by numerous minute striæ or lines of growth (which are more or less regular and clear, probably owing to the state of preservation of the fossils), which curve slightly rearwards on the lower part of the back, and then slightly forward again below. Shoulder (just within the suture on the inner whorls and just above the greatest diameter of the shell on the outer whorl) often bearing a line of frequent scars of attachment, which do not preserve any trace of impressed ornament, so that the attached bodies were possibly stones and not shells.

Size.—Height 6 mm., width 22 mm.

Localities.—This species appears to be rather common. There are two specimens, one bearing scars, in Mr. Lee's Collection in the British Museum, and four in the Woodwardian Museum from Lummaton. There are seven specimens in Mr. Vicary's Collection and two in the Museum of Practical Geology from Wolborough; and there are seven in the Torquay Museum, of which five are in the Battersby Collection, from these two localities.

Remarks.—The above description is taken chiefly from a shell in the Torquay Museum and a shell of Mr. Vicary's. These shells differ only in the striæ of the latter being more regular; in both cases they are equally microscopic. They accurately correspond with the two best figures (*a*, *b* only) of Phillips's *Euomphalus serpens*, and clearly belong to that species. In Mr. Vicary's shell there are no signs of scars; and, indeed, only two of the Torquay specimens show them, the others being, however, mostly in the condition of casts.

I have not met with Phillips's type, but Mr. Vicary's specimen is so exactly similar as to answer the same purpose. As the markings are only visible under a strong lens, Phillips's description of it as smooth may be regarded as approximately accurate.

At page 138 of the 'Pal. Foss.' he describes another shell, *Eu. annulatus*, Phil., as identical with that figured as pl. xxxvi, fig. 172 *a*, *b*, from which, however, it distinctly differs both in the number of its whorls and the coarseness of its ribbing.

In fact, under the heading of *Eu. serpens* and *Eu. annulatus* in the 'Pal. Foss.' Phillips, as he himself seems aware, has included several separate species of shells. Four, if not five, very distinct forms are recognisable, viz.:

No. 1. Figs. 172 *a*, *b*,—practically smooth, flat, horizontally symmetrical.

No. 2. Fig. 172*,—finely ribbed, flat, of many whorls.

No. 3. Fig. 172 *f*,—strongly ribbed below, few whorls, deep umbilicus.

No. 4. Fig. 172 *g*,—spire flatly conical, strongly ribbed (?), of few whorls.

No. 5. Figs. 172 *c*—*e*,—flatly conical, minute, smooth, of many whorls.

(*a*) It seems best to regard No. 1 as the type of the restricted species *Eu. serpens*, Phillips, as that species agrees best with his description, and is well represented by his first and most prominent figures.

(β) No. 2 must evidently be taken as the type of *Euomphalus annulatus*, Phillips. There can be no doubt that the specimen in the Museum of Practical Geology is the original of this figure, and it certainly belongs to a well-marked and distinct species.

(γ) No. 3 is represented by a poor and almost unrecognisable figure of the umbilical side. The authorities of the British Museum regard a shell in the Lee Collection as the original of this figure, and the accidental marks of the specimen make it almost certain that they are right in doing so. As the figure is so poor, and does not agree with Phillips's description, it has no right to the original name of *Eu. serpens*. This shell, as will be seen below, in all probability belongs to the species described by me as *Eu. fenestralis*.

(δ) No. 4 is represented by a figure of the upper side only. Phillips regards it as the same as No. 3, saying on page 222, "They (figs. 172*f* and *g*) have a different aspect from the rest." It is, however, quite different from the upper surface of my *Eu. fenestralis*, and its figure does not seem to me to be likely to correspond with the type of fig. 172*f*. I have been unable to discover the original specimen. It appears to me, however, to agree with *Eu. Hecale*, Hall, except that it shows signs of strong ribbing. Until either the type or more perfect specimens agreeing with it are found it will be difficult to differentiate it with certainty.

(ε) The last form, No. 5, is a minute, many-whorled, and more globose shell. It probably comes from North Devon. It differs from all except No. 4 in having a more conical spire, and from No. 4 in having more slowly increasing whorls, and probably in being smooth. It has been recognised by M'Coy[1] from the Carboniferous beds, and there are specimens of it in the Bristol Museum.

Hence for the form now under description we may retain Phillips's name, especially as it appears to be the shell which subsequent authors have generally understood to represent his species.

In it the spire is so depressed that it is sometimes difficult to distinguish the top of the shell from the bottom, but at other times the lower side of the aperture is slightly angulated.

I can see no difference between *Eu. orbis*, Eichwald, or *Eu. clymenoides*, Hall, and the English shell, except that they are not elliptically coiled and bear no attachment scars; but these are not constant features in this species.

Affinities.—*Eu. æqualis*, Sowerby,[2] from the Mountain Limestone, is very similar, but it has more numerous and more slowly increasing whorls.

The young of *Euomphalus Goldfussi*, d'Archiac and de Verneuil,[3] has decussating and more undulating striæ.

[1] 1844, M'Coy, 'Syn. Carb. Foss. Ireland,' p. 37.

[2] 1816, Sowerby, 'Min. Conch.,' vol. ii, p. 89, pl. cxl, fig. 1.

[3] 1842, d'Arch. and de Vern., 'Geol. Trans.,' ser. 2, vol. vi, pt. 2, p. 362, pl. xxxiv, figs. 1, 1 *a*, 2, 2 *a*.

Eu. serpens,[1] as given by Goldfuss,[2] from the Carboniferous rocks, may be the same species, though appearing a rather higher shell, and flatter above.

Phanerotinus Eboracensis, Hall, is described and figured as having similar scars of attachment of fragments of shells, but its spire is free and slightly elevated.

In the British Museum is a *Euomphalus* from the Middle Devonian of Teignmouth, with a smooth and sunken spire, which only differs from the present shell by having much more numerous, smaller, and more slowly increasing whorls. An apparently similar specimen is in the Torquay Museum.

2. *Genus*.—Euomphalus, *Sowerby*, 1814.

This large genus begins in the Cambrian or Lower Silurian, and reaches the Trias, even if some Cretaceous species of Solarium ought not to be included in it. There is a considerable amount of variability among its species, in the ornament, in the sectional shape of the whorls, and in the elevation of the spire.

It appears that the name *Straparollus*, Montf., 1810, has the priority, but Sowerby's name is so generally used that a change would be inadvisable.

Zittel divides it into several sub-genera, placing smooth species in *Straparollus*, and striated and spirally keeled species in *Euomphalus*. Some of the species—as, for instance, *Eu. rota* and *Eu. radiatus*—seem so like the genus *Discohelix*, Dunker, 1851, reaching from the Trias to the present time, that, as far as the shell is concerned, the only distinguishing mark appears to be the forward, instead of backward, curving of the striæ on the back.

1. Euomphalus Dionysii, *de Montfort*, sp. Pl. XXIII, figs. 20, 20 *a*.

1810. Straparollus Dionysii, *de Montfort*. Conch., vol. ii, p. 174.
1813. Helicites Dionysii, *Schlotheim*. Jahrbuch, vol. vii, p. 85.
1820. — priscus, *Schlotheim*. Petrefakten-Kunde, vol. ii, p. 60, pl. x, fig. 1.
1820. — trochilinus, *Schlotheim*. Ibid., vol. ii, p. 60, pl. x, fig. 2.

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[1] 1844, Goldfuss, 'Petref. Germ.,' vol. iii, p. 88, pl. cxci, figs. 8 *a*, *b*.
[2] 1879, Hall, 'Pal. N. Y.,' vol v, pt. 2, p. 61, pl. xvi, figs. 19—23.

1820. HELICITES ELLIPTICUS, *Schlotheim*. Ibid., vol. ii, p. 60, pl. x, fig. 3.
1823. CIRRUS ROTUNDATUS, *Sowerby*. Min. Conch., vol. v, p. 86, pl. ccccxxix, figs. 1, 2.
1836. — — *Phillips*. Geol. Yorks., vol. ii, p. 226; pl. xiii, fig. 15; and pl. xv, fig. 32.
1840. EUOMPHALUS HELICIFORMIS, *Münster*. Beitr., pt. 3, p. 85, pl. xv, fig. 6.
1842. CIRRUS ROTUNDATUS, var., *d'Arch.* and *de Vern.* Geol. Trans., ser. 2, vol. vi, pt. 2, p. 389.
1844. EUOMPHALUS ANGUIS, *M'Coy*. Syn. Carb. Foss. Ireland, p. 35, pl. iii, fig. 11.
1848. STRAPAROLLUS PRISCUS, *d'Orbigny*. Prodrome, p. 65.
1848. — DIONYSII, *d'Orbigny*. Ibid., p. 120.
1853. EUOMPHALUS LÆVIS, var. TURRITUS, *Sandberger*. Verst. Rhein. Nassau, p. 213, pl. xxv, figs. 7, 7 *a*, 7 *b*.
1854. — DIONYSII, *Morris*. Cat. Brit. Foss., p. 247.
1857. — VORTEX, *Eichwald*. Bull. Soc. Nat. Moscov., p. 166.
1860. — — — Lethæa Rossica, p. 1150, pl. xlii, figs. 15 *a*, *b*.
1876. — DIONYSII, *F. Römer*. Lethæa Pal., pt. 1, pl. xlv, fig. 9.
1878. — OPHIRENSIS, *Hall* and *Whitfield*. Rep. Geol. Fortieth Parallel, by C. King, pt. 2, p. 261, pl. iv, figs. 26, 27.
1881. — DIONYSII, *de Koninck*. Ann. Musée Royal H. N. Belgique, vol. vi, pt. 3, p. 120, pl. xiii, figs. 8—10; and pl. xiv, figs. 16, 18.

Description.—Shell small, conical, depressed, of numerous slowly increasing whorls. Spire forming a low cone of about five volutions. Suture deep and wide. Whorls smooth, spreading horizontally from the suture, nearly circular in section. Shell-structure smooth.

Size.—Height 10 mm., width about 15 mm.

Locality.—Lummaton. There is a specimen in the Woodwardian Museum.

Remarks.—*Euomphalus Dionysii* is a well-known and common Carboniferous species, which has been described by many authors from de Montfort to de Koninck, who has given a very long synonymy. Whether it is also to be registered in the Devonian list is much more open to question. Various fossils have been described by various palæontologists under several names from Devonian rock which are very similar, and which there is much reason to regard as identical, especially as the Carboniferous species is subject to a considerable amount of variation, which is sometimes such as to include the Devonian forms.

The small shell in the Woodwardian Museum is the only evidence of its occurrence in the localities now under notice, and this shell is not sufficiently perfect to enable us to come to a very positive decision in the matter. There are numerous specimens of *Eu. Dionysii* from Carboniferous beds in the British Museum and the Museum of Practical Geology, and several others are figured by de Koninck.

Some of these have rather more sloping sides, but others, except that they are larger and better specimens, seem exactly like it.

The Lummaton fossil also agrees so perfectly with the figure which Schlotheim gives of his *Helicites priscus* as evidently to be specifically identical with it. It does not seem clear from Schlotheim's description whether that was a Devonian or a Carboniferous shell. If the latter, it is simply a synonym of *Eu. Dionysii;* but d'Orbigny regards it as Devonian, and quotes it from Paffrath, and if that be the case I think we are obliged to regard the Woodwardian fossil as an example of Schlotheim's, and therefore of de Montfort's species.

Schlotheim's two other species are certainly Carboniferous fossils which are identical with *Eu. Dionysii.*

Again, our English fossil appears to be so like *Euomphalus heliciformis*, Münster, that there can be little room for doubt that, although the body-whorl certainly seems wider, it also is the same shell.

Eu. lævis, var. *turritus*, Sandberger, is a little more elevated, but it clearly corresponds with it, and must be regarded as a synonym.

Eu. vortex, Eichwald, on the other hand, has a slightly lower spire, a wider and deeper suture, and rather more slowly increasing whorls, which are more transversely oval in section. Thus it varies from *Eu. Dionysii* in the opposite direction to Sandberger's shell, but it still comes so close that I am very much inclined to regard it as identical.

Cirrus rotundatus and *Eu. ophirensis* are quoted as Carboniferous synonyms upon the authority of de Koninck.

Affinities.—The Devonian shell differs from *Eu. circularis*, Phillips, in having much more numerous and slowly increasing whorls, and generally a higher spire. From *Eu. lævis* it is distinguished by its coiling being distinctly conical, and more definite and regular than it is in that shell. There is certainly just a possibility of its proving to be identical with that shell, especially as it bears upon its surface suspicious-looking fractures which might perhaps be supposed to indicate agglutinations. But even if this were so, it would of course still remain a question whether *Pl. lævis*, d'Arch. and de Vern., should on that account be merged into de Montfort's shell. This is very unlikely, but it could only be finally solved by the discovery of more numerous and better English specimens, or by the examination of a larger number of foreign examples than those to which I have myself had access.

2. EUOMPHALUS HECALE, *Hall*. Pl. XXIV, figs. 7, 7 *a*, 8, 8 *a*.

? 1841.	EUOMPHALUS SERPENS, *Phillips* (pars).	Pal. Foss., p. 94, pl. xxxvi, fig. 172 *g* (only).
? 1843.	— DEPRESSUS, *Hall* (not *Goldfuss*).	Geol. N. Y., Surv. Fourth Geol. Dist., p. 291.
1867.	— SERPENS, *Semenow* and *Möller*.	Ober-Dev. Schicht. Mittl. Russlands, p. 675, pl. iv, figs. 4 *a*, *b*.
1879.	— HECALE, *Hall*.	Pal. N. Y., vol. v, pt. 2, p. 59, pl. xvi, figs. 10—14.
1889.	— LÆVIS, *Whidborne*.	Geol. Mag., dec. 3, vol. vi, p. 30.

Description.—Shell small, depressed, elliptically coiled, nearly discoidal, of three or four rapidly increasing whorls. Spire forming a very low cone. Suture deep and wide. Whorls transversely elliptic in section, rising gently from the suture and being slightly convex on the upper surface, becoming very convex round the back, and being decidedly convex, or possibly subangulated, below. Umbilicus large and deep, exposing the rounded inner sides of the whorls. Surface smooth, or marked with indistinct growth-lines.

Size.—Height about 10 mm., width about 22 mm.

Localities.—In Mr. Champernowne's Collection there is one specimen from Wolborough and one from Lummaton. In the Museum of Practical Geology there is a specimen from Wolborough. In the British Museum there is a specimen from Wolborough, which perhaps belongs to the same species.

Remarks.—I formerly thought that these fossils were a variety of *Eu. lævis*, d'Archiac and de Verneuil,[1] as the figure of that species given by Sandberger[2] seemed to approach them more nearly than does the original figure of the French authors. However, a further comparison has convinced me that that view cannot be sustained, as the English fossils are definitely conical, and their whorls are decidedly fewer and more oval in section, and increase much more rapidly.

Moreover, Prof. Kayser has united *Eu. lævis* with *Eu. planorbis*, d'Archiac and de Verneuil,[3] while the various figures of the German shells leave little doubt that he is correct in doing so; the English fossils which I have above referred to that form are evidently distinct from those now under notice.

On the other hand, these fossils appear almost exactly to correspond with *Euomphalus serpens*, Semenow and Möller (not Phillips), and I can find no grounds

[1] 1842, d'Archiac and de Verneuil, 'Geol. Trans.,' ser. 2, vol. vi, pt. 2, p. 363, pl. xxxiii, figs. 8, 8 *a*.

[2] 1853, Sandberger, 'Verst. Rhein. Nassau,' p. 213, pl. xxv, figs. 6, 6 *a*, 6 *b*.

[3] 1842, d'Archiac and de Verneuil, 'Geol. Trans.,' ser. 2, vol. vi, p. 363, pl. xxxiii, figs. 7, 7 *a*.

for distinguishing them from the American species described as *Euomphalus Hecale* by Hall, whose description, however, is rather vague in one or two particulars.

Affinities.—This shell has much the appearance of a small or young variety of *Euomphalus circularis*, Phillips, but it quite differs from it in the shape of its whorls, and in the almost entire absence of any depression round the suture.

Euomphalus Dionysii, Montfort, is distinguished by its more elevated spire, and its more numerous, circular, and more slowly increasing whorls. In *Euomphalus lævis*, var. *turritus*, Sandberger, which appears to me distinct from *Eu. lævis*, and probably a variety of *Eu. Dionysii*, the spire is still more elevated.

Straparollus grandis, de Koninck,[1] is a very much larger form, and its whorls are rather fewer and more horizontally flattened.

3. Euomphalus circularis, *Phillips*. Pl. XXIV, figs. 9, 10.

1840.	Euomphalus circularis,	*Phillips*.	Pal. Foss., p. 94, pl. xxxvi, fig. 171.
1854.	—	—	*Morris*. Cat. Brit. Foss., p. 247.
1888.	—	—	*Etheridge*. Foss. Brit., vol. i, Pal., p. 163.

Description.—Shell very large, spiral, turrited, very depressed, so as to be almost lenticular, of three or four volutions. Spire very low, loosely and rather irregularly coiled. Suture shallow, obtuse. Whorls subquadrate or subcircular; after rising slightly close to the suture spreading out flatly to the shoulder, where they turn through a blunt angle and become gently and uniformly convex on the back, at the bottom of which they turn through a still greater angle, which bounds the base. Base flat or slightly convex, sloping inwards, forming a narrow border round the wide, deep umbilicus, which is marked within by a sharp, deep, sutural, spiral trench or excavation. Mouth (or section of whorl) subquadrate or subcircular. Shell-structure rather thin.

Size.—Height 30, width 52 mm.

Localities.—From Wolborough there are three examples in Mr. Vicary's Collection, three in the British Museum, and several in the Museum of Practical Geology. There are four specimens in the Torquay Museum, two of which seem to have come from Lummaton and two from Wolborough. There is a very large specimen from Lummaton, showing the umbilical side, in the Woodwardian Museum, and another in my Collection.

Remarks.—Phillips's type of this species is in the Museum of Practical Geology, but at the time that the specimens for figuring were selected we had not recog-

[1] 1881, de Koninck, 'Ann. Mus. Roy. H. N. Belg.,' vol. vi, p. 126, pl. xix, figs. 10, 11.

nised it, and consequently, as other specimens seemed to show the characters of the shell better, it has not been reproduced. This specimen is slightly smaller than his figure, which fairly represents it, though drawn upon the slant. It has a rather flattened band on the shoulder, and below this on the back are some indistinct and doubtful signs of spiral striæ, which are much exaggerated in Phillips's drawing. It appears to be very like fig. 10 of our plate, which would still more resemble it if its surface had not been so much worn away.

Phillips mentions in his description "some traces of spiral striæ;" these cannot be seen in many of the specimens, probably because they have been obliterated by the decortication which is characteristic of so many Wolborough fossils, and which has more or less affected all the examples of this shell that I have seen. They are, however, to be observed upon one or two of them, as upon Phillips's type specimen, and on the British Museum specimen, Pl. XXIV, fig. 11. The specimens from Lummaton, which might have preserved the ornament, are unfortunately only exposed on the umbilical side, and indeed show so little character that it is only presumptively that they can be referred to this species.

Some of the most distinctive features of the species are the horizontal flattening and falling in of the upper part of the whorls, and the low blunt angle of the shoulder, which seems to be caused by the thickening of the substance of the shell at that point. These characters are seen developed to a much greater extent in the Carboniferous species *Eu. æqualis*, Sowerby, sp.,[1] and *Eu. marginatus*, M'Coy.[2] *Eu. pentangulatus*, Sowerby,[3] another Carboniferous species, has a much sharper and more elevated keel upon the shoulder, and the part above it is inclined at a higher angle to the suture.

As will be seen from the figures we give, this species is subject to considerable variation. Indeed, if we had a larger number of specimens to judge from, it is possible that they might prove that we have included more than one species under this head. Thus the shell delineated in fig. 10 gives the most usual form; that given in fig. 9 is a variety with the upper part of the whorl almost quite flat and horizontal, and with a much sharper angle at the shoulder, so that it is hardly to be distinguished from *Eu. æqualis*, Sow.; while in that given in fig. 11 the differences are so marked that I have separated it below as a named variety.

Affinities.—Where, as is usually the case with the Wolborough specimens, the surface is much decayed, it often becomes very difficult to distinguish specimens of *Pleurotomaria delphinuloides*, Schlotheim, from this species. They appear, however, to be distinguished by having a higher spire, and by the whorls sloping downwards and not upwards from the suture to the shoulder.

[1] 1816, Sowerby, 'Min. Conch.,' vol. ii, p. 89, pl. cxl, fig. 1.
[2] 1844, M'Coy, 'Syn. Carb. Foss. Ireland,' p. 36, pl. v, fig. 21.
[3] 1814, Sowerby, 'Min. Conch.,' vol. i, p. 97, pl. xlv, figs. 1, 2.

Euomphalus Dionysii, Montfort, has a more elevated spire and less rapidly increasing whorls.

In *Euomphalus trigonalis*, Goldfuss,[1] the spire is lower, and there is a more definite concavity on the upper part of the whorls near the suture, somewhat like that seen in Sowerby's figure of his large specimen of *Nerita speciosa*, Sowerby.[2]

4. Euomphalus circularis, *Phillips*, var. gemmulifer, var. nov. Pl. XXIV, fig. 11.

One of the specimens of *Euomphalus circularis* from Wolborough in the British Museum is, as mentioned above, so different from the rest that I have thought it best to distinguish it as a named variety. Possibly if further and better specimens are found it may prove to be a distinct species. It is elliptically coiled in about four volutions. Its spire, though conical, is so depressed that the apex is decidedly below the plane through the shoulder of the body-whorl. The section of the whorls is distinctly trigonal, the upper surface rising obliquely and flatly to the shoulder, the back being moderately convex, and the base also flatly oblique. Upon the shoulder is a prominent, elevated, rounded ridge or keel, between two narrow concavities, which is divided into beads by numerous transverse striæ, visible only upon this keel. Upon the back are indications of several fine spiral threads, rather closely arranged. The umbilicus is very large and shallow.

Affinities.—*Euomphalus catilliformis*, de Koninck,[3] is very similar to this shell, but in it the raised keel is situated much lower down upon the whorl and further from the suture than it is in the Devonian specimen.

5. Euomphalus annulatus, *Phillips*. Pl. XXIV, figs. 6, 6 *a*.

1841.	Euomphalus annulatus, *Phillips*.	Pal. Foss., p. 138, pl. 60, fig. 172*.
1841.	— annulosus, *Phillips*.	Ibid., p. 231.
1842.	— annulatus, *d'Arch.* and *de Vern.*	Geol. Trans., ser. 2, vol. vi, pt. 2, p. 363, pl. xxxiii, figs. 11, 11 *a*.
1844.	— — *Goldf.*	Petref. Germ., vol. v, p. 82, pl. clxxxix, fig. 9.

[1] 1844, Goldfuss, 'Petref. Germ.,' vol. iii, p. 81, pl. clxxxix, figs. 5, 5 *a*.

[2] 1840, Sowerby, 'Geol. Trans.,' ser. 2, vol. v, pt. 3, pl. lvii, fig. 15.

[3] 1881, de Koninck, 'Ann. Mus. Roy. H. N. Belg.,' vol. vi, p. 146, pl. x, figs. 39—41.

PLATE XVI.

MACROCHILINA SUBCOSTATA, *Schlotheim*, sp. (Page 159.)

FIG.

1. Large specimen. Wolborough. Vicary Collection.
2. Lower part of another large specimen, showing the callosity on the inner lip; 2 *a*, portion of surface, × 2·5. Lummaton. My Collection.
3. Original specimen of *Macrochilus arculatus*, Phillips (not Schlotheim). Wolborough. Museum of Practical Geology.
4. A specimen transversely crushed, but drawn obliquely so as to give nearly the true shape of the shell. Lummaton (?). Torquay Museum.
5. Another specimen, wanting the body-whorl. Barton. British Museum.
6. Another specimen. Wolborough. Torquay Museum.
7. Original specimen of *Macrochilus elongatus*, Phillips. Wolborough. Museum of Practical Geology.

MACROCHILINA ARCULATA, *Schlotheim*, sp. (Page 162.)

8, 8 *a*. Two views of an elongate specimen. Chudleigh. Vicary Collection.

9. A stouter specimen; 9 *a*, portion of surface, × 2·5. Chudleigh. Vicary Collection.

MACROCHILINA LINCTA, *Phillips*, sp. (Page 163.)

10. A specimen showing sculpture, × 2. Lummaton. Lee Collection. British Museum.

1.

2.

9.

10

5.

6.

3.

4.

2a.

X3.

9a.

X3.

7.

8.

8a.

PLATE XVII.

MACROCHILINA IMBRICATA, *Sowerby*, sp. (Page 164.)

FIG.

1. Large specimen, somewhat crushed. Wolborough. Vicary Collection.
2. Another crushed specimen. Wolborough. Museum of Practical Geology.
3. Another specimen, defective in front. (The spire should be a little higher than it appears in the figure.) Barton? Torquay Museum.
4, 4 *a*. Small specimen, with rather higher spire. Chudleigh. Vicary Collection.

MACROCHILINA SUBIMBRICATA, *d'Orbigny*, sp. (Page 166.)

5, 6. Large specimens, with defective body-whorls. Wolborough. Vicary Collection.
7. Another specimen. Lummaton. My Collection.

MACROCHILINA VENTRICOSA, *Goldfuss*, sp. (Page 167.)

8. Large specimen; 8 *a*, another view, showing mouth, but with shell partly destroyed. Wolborough. Museum of Practical Geology.
9. Another specimen, with defective body-whorl. Wolborough. Museum of Practical Geology.

MACROCHILINA, AFF. ACUTA, *Sowerby*, sp. (Page 168.)

10. Specimen with surface destroyed; 10 *a*, another view, showing mouth. Wolborough. Vicary Collection.

MACROCHILINA ELEVATA, n. sp.? (Page 170.)

11, 11 *a*. A specimen whose shape is much obscured by matrix. Lummaton. My Collection.
12, 12 *a*. A much worn specimen, × 2. Wolborough. Museum of Practical Geology.

MACROCHILINA EJECTA, n. sp. (Page 170.)

13. Specimen showing the flatness of the whorls and the angulated form of the lower part of the body-whorl, × 2. Barton. British Museum.

TURBO PENGELLII, *Whidborne*. (Page 274.)

14. A worn and rather crushed specimen, × 2. Lummaton. Torquay Museum.

NATICA MERIDIONALIS, *Phillips?* (Page 196.)

15. Specimen wanting the body-whorl; 15 *a*, another view, showing signs of another whorl, × 2; 15 *b*, apical whorls, × 3. Wolborough. Vicary Collection.

SPANIONEMA SCALAROIDES, *Whidborne*, sp. (Page 185.)

16. Specimen with worn surface; 16 *a*, another view of the body-whorl. Wolborough. Torquay Museum.
17. Another specimen, retaining surface. Wolborough. Vicary Collection.

LOXONEMA ROEMERI, *Kayser*. (Page 172.)

18. Specimen retaining the shell, though slightly worn, × 2; 18 *a*, a whorl of the same shell still more enlarged. Wolborough. Museum of Practical Geology.
19. Another fragmentary specimen, partly obscured by matrix, × 2. Lummaton. My Collection.

HOLOPELLA TENUISULCATA, *Sandberger*. (Page 225.)

20. Specimen retaining test; 20 *a*, portion of surface, × 5. Lummaton. Woodwardian Museum.

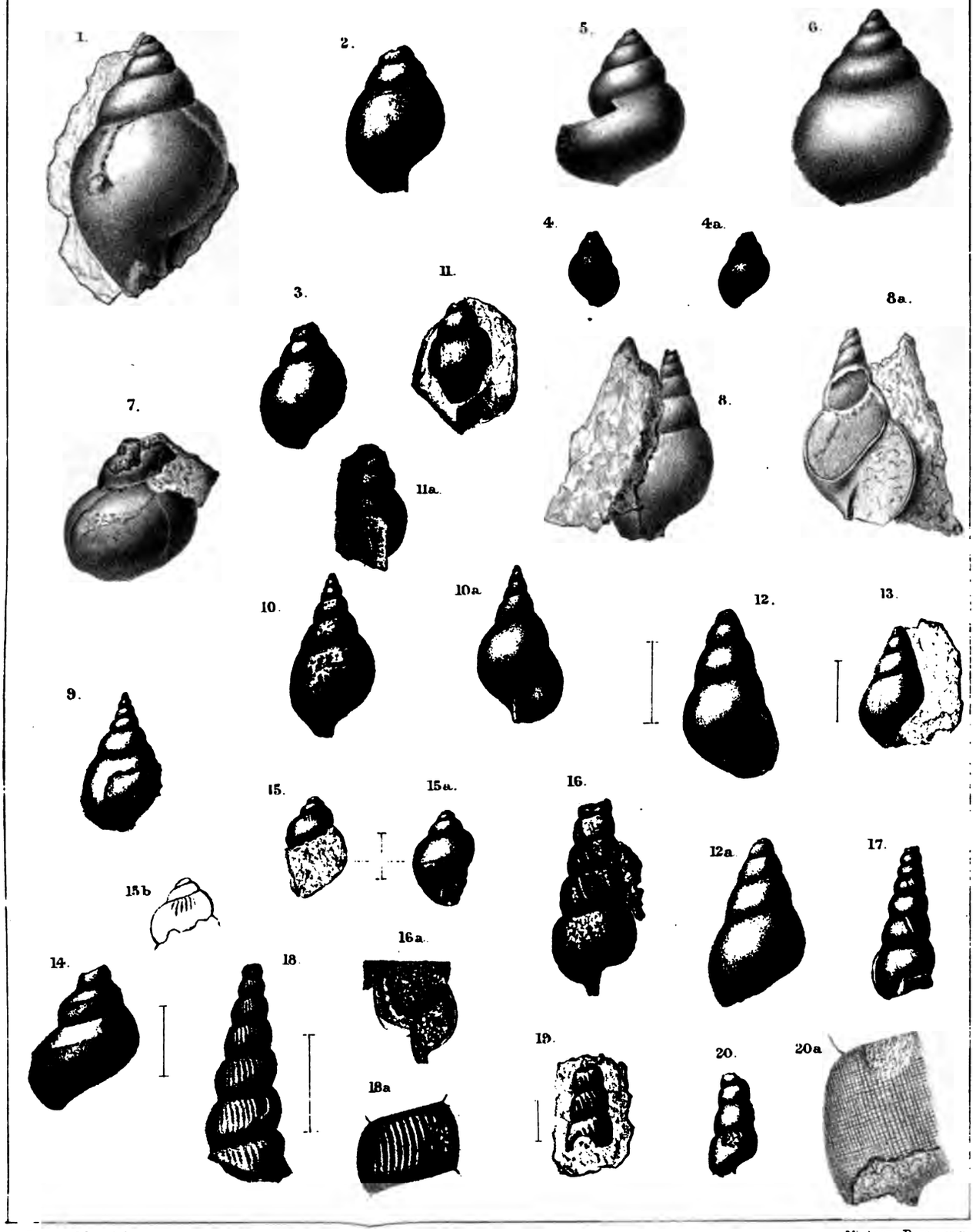

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PLATE XVIII.

LOXONEMA RETICULATUM, *Phillips*. (Page 177.)

FIG.

1. Large specimen with a thick shell. Wolborough. Museum of Practical Geology.
2. Still larger specimen with a very thick shell, one of the figured specimens of *L. præteritum*, Phillips. Chudleigh. Museum of Practical Geology.
3, 3 *a*. Original figured specimen of *L. reticulatum*; 3 *b*, a single whorl, × 1·5. Wolborough. Museum of Practical Geology.

LOXONEMA? sp. (Page 178.)

4. Internal mould of an imperfect specimen. Wolborough. Vicary Collection.

LOXONEMA SCALARIÆFORME, *Holzapfel*, sp. (Page 179.)

5. Specimen with exterior partially worn away. Wolborough. Vicary Collection.

MICHELIA, sp. (Page 183.)

6. Internal mould of an imperfect specimen. Wolborough. Vicary Collection.

LOXONEMA CONICUM, n. sp. (Page 180.)

7. Specimen retaining test though rather worn, showing the flatness of the whorls and the slightness of the suture; 7 *a*, portion of surface, × 1·5. Wolborough. Torquay Museum.
8. Internal mould of a shell probably of the same species. Wolborough. Torquay Museum.

HOLOPELLA TENUIRETICULATA, n. sp. (Page 224.)

9. Specimen retaining test; 9 *a*, another view, showing the variation in the sutural angle; 9 *b*, portion of surface, × 4. Wolborough. Vicary Collection.

HOLOPELLA TENUISULCATA, *Sandberger*. (Page 225.)

10. Specimen retaining test; 10 *a*, portion of surface, × 2. Wolborough. Vicary Collection.
11. Similar specimen wanting test, × 1·5. Wolborough. Museum of Practical Geology.

HOLOPELLA DUPLISULCATA, *Whidborne*. (Page 227.)

12. Body-whorl of a specimen partly retaining test; 12 *a*, portion of surface, × 2; 12 *b*, portion of the same, × 5. Lummaton. My Collection.
13. Another specimen, consisting of two whorls, × 2. Lummaton. My Collection.
14. Another specimen, retaining surface, × 1·5; 14 *a*, a single whorl more enlarged; 14 *b*, a small portion still more enlarged. Wolborough. Champernowne Collection.

HOLOPELLA COSTATA, *Sandberger*, sp. (Page 229.)

15. Specimen retaining shell, × 1·5; 15 *a*, portion of surface enlarged. Wolborough. Museum of Practical Geology.

HOLOPELLA HENNAHIANA, *Sowerby*, sp. (Page 228.)

16. Specimen retaining test, × 1·5; 16 *a*, one whorl, × 3. Lummaton (?). Torquay Museum.

LOXONEMA PRISCUM, *Münster*, sp. (Page 181.)

17. Internal mould of a specimen. Wolborough. Museum of Practical Geology.
18. Another specimen, × 1·5. Lummaton (?). Torquay Museum.
19, 19 *a*. Another specimen, retaining test, × 1·5. Lummaton. Torquay Museum.

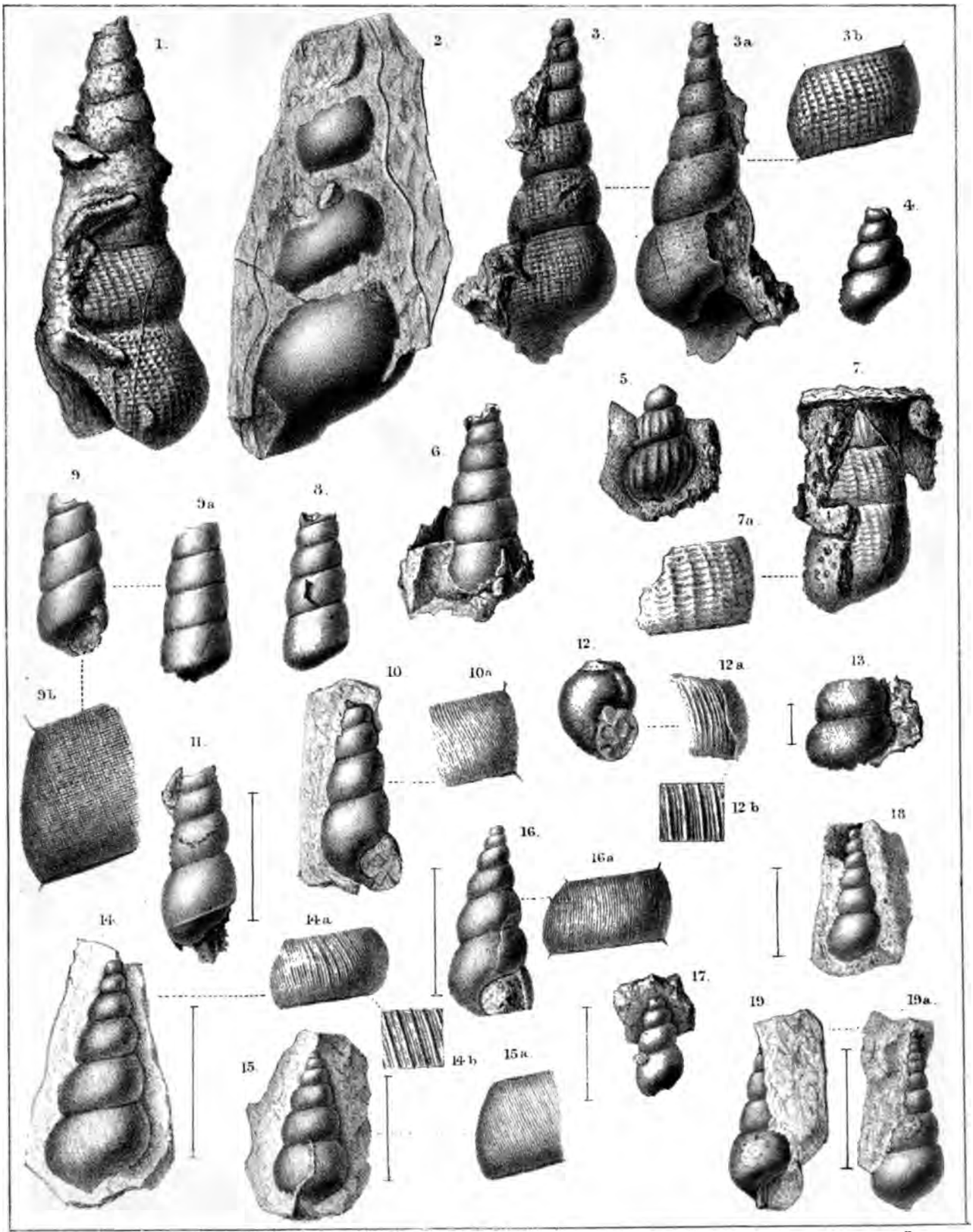

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PLATE XIX.

NATICA NEXICOSTA, *Phillips*. (Page 192.)

FIG.

1. Specimen, × 2·5. Lummaton. Torquay Museum.

NATICA ANTIQUA, *Goldfuss*. (Page 193.)

2. Specimen, × 4; 2 *a*, another view, with outline of mouth restored. Lummaton (?). Torquay Museum.

NATICOPSIS HARPULA, *Sowerby*, sp. (Page 189.)

3. Large but injured specimen, showing the fine ridges on the lower part of the whorl; 3 *a*, another view, showing the coarse ridges on the upper part of the whorl. Chudleigh. Vicary Collection.
4. Small specimen showing the bifurcation of the ridges, × 4. Chudleigh. Vicary Collection.

LITTORINA DEVONICA, *Whidborne*. (Page 186.)

5, 5 *a*. Two views of a large and very perfect specimen, × 2. Chudleigh. Vicary Collection.

LITTORINA USSHERI, n. sp. (Page 188.)

6, 6 *a*. Two views of a large specimen wanting spire. Lummaton. My Collection.
7, 7 *a*. Two views of another specimen, longitudinally distorted, × 2. Chudleigh. Vicary Collection. *N.B.—On the Plate, 7 b is a misprint for 8 b.*
8, 8 *a*, 7 *b*. Three views of another specimen, obliquely distorted so as to narrow the front part of the mouth, × 2. Chudleigh. Vicary Collection.

PLATYOSTOMA SIGMOIDALE, *Phillips*, sp.? (Page 198.)

9. Specimen preserving surface, which is marked by undulating striæ, × 2·5. Lummaton (?). Torquay Museum.
10. Another specimen, wanting apex, × 2; 10 *a*, portion of surface much more enlarged. Lummaton. My Collection.

STROPHOSTYLUS, sp. (Page 197.)

11. A distorted specimen which wants the shell; 11 *a*, apical view. Probably from Chircombe Bridge. British Museum.

CAPULUS? INVICTUS, n. sp. (Page 204.)

12. Lateral view of a large specimen; 12 *a*, apical view. Barton. British Museum.
13. Lateral view of another specimen, × 2; 13 *a*, apical view. Lummaton. My Collection.
14. Apical view of large specimen, partially retaining colour-bands, and showing its sinuous peristome and elliptic coiling; 14 *a*, basal view, showing a deep basal furrow; 14 *b*, 14 *c*, lateral views. Wolborough. Vicary Collection.

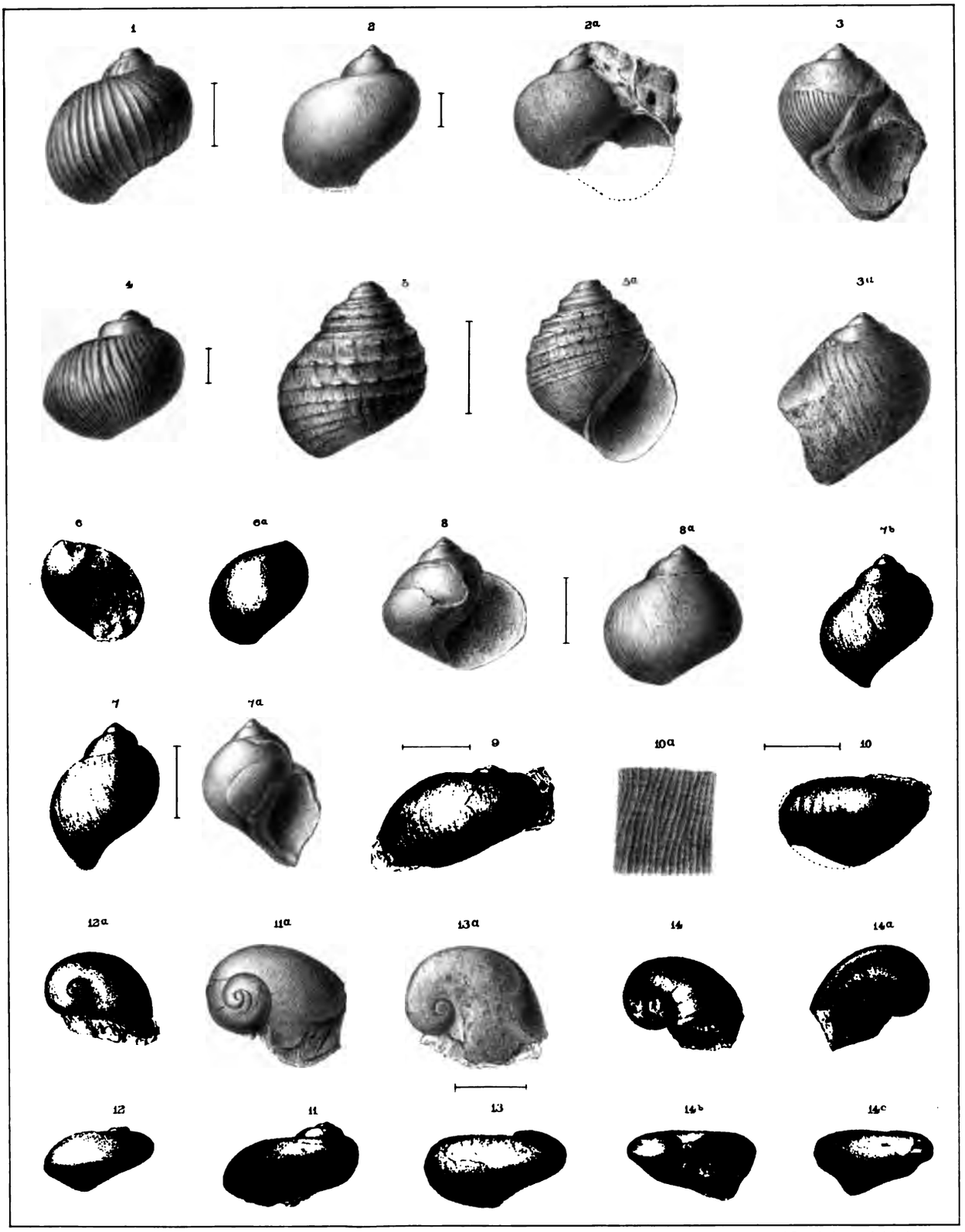

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PLATE XX.

CAPULUS PERICOMPSUS, n. sp. (Page 205.)

FIG.

1. Upper view of a specimen with unusually angulated whorls; 1 *a*, lateral view; 1 *b*, apical view. Lummaton. My Collection.
2. Upper view of another specimen, × 1·5; 2 *a*, apical view. Lummaton. My Collection.
3. Apical view of another specimen; 3 *a*, upper view. Lummaton. Woodwardian Museum.
4. Apical view of a stouter specimen; 4 *a*, upper view. Lummaton. My Collection.
5. Apical view of a stouter and slightly furrowed specimen; 5 *a*, upper view. Wolborough. Vicary Collection.

CAPULUS ROSTRATUS, *Trenkner?* (Page 207.)

6. Upper view of a specimen partially retaining test × 2; 6 *a*, apical view. Lummaton. My Collection.
7. Upper view of another specimen; 7 *a*, apical view; 7 *b*, basal view, showing the deep concavity of the base. Lummaton. My Collection.
8. Upper view of a very large specimen with a close, well-developed spire; 8 *a*, dorsal view. Wolborough. Vicary Collection.

CAPULUS COMPRESSUS, *Goldfuss*, sp. (Page 208.)

9. Upper view of the apical portion of a shell, retaining its colour-bands, × 5; 9 *a*, apical view. Lummaton. Woodwardian Museum.
10. Apical view of the apical portion of another shell, retaining colour-bands, × 2; 10 *a*, basal view. Lummaton. My Collection.
11. Upper view of a higher specimen, in which the apex is wanting; 11 *a*, apical view. Lummaton. My Collection.

CAPULUS PUELLARIS, n. sp. (Page 210.)

12. Upper view of a large but doubtful specimen with slowly increasing whorl; 12 *a*, apical view. Lummaton. My Collection.
13. Upper view of a high but perhaps crushed specimen; 13 *a*, apical view. Wolborough. Museum of Practical Geology.
14. Upper view of a specimen showing ribs near mouth; 14 *a*, apical view. Lummaton. My Collection.
15. Upper view of a specimen with a spiral apex and numerous ribs; 15 *a*, apical view. Lummaton. My Collection.

CAPULUS TERMINALIS, n. sp. (Page 211.)

16. Upper view of a specimen with very elongated apex; 16 *a*, apical view. Lummaton. My Collection.

NOTE.—*These shells are here treated in the same way as ordinary Gasteropods; the "upper," "lateral," and "apical" views respectively indicating them as seen from above, from the side near the mouth, and from the side near the apex.* (*See* , *note* 8.)

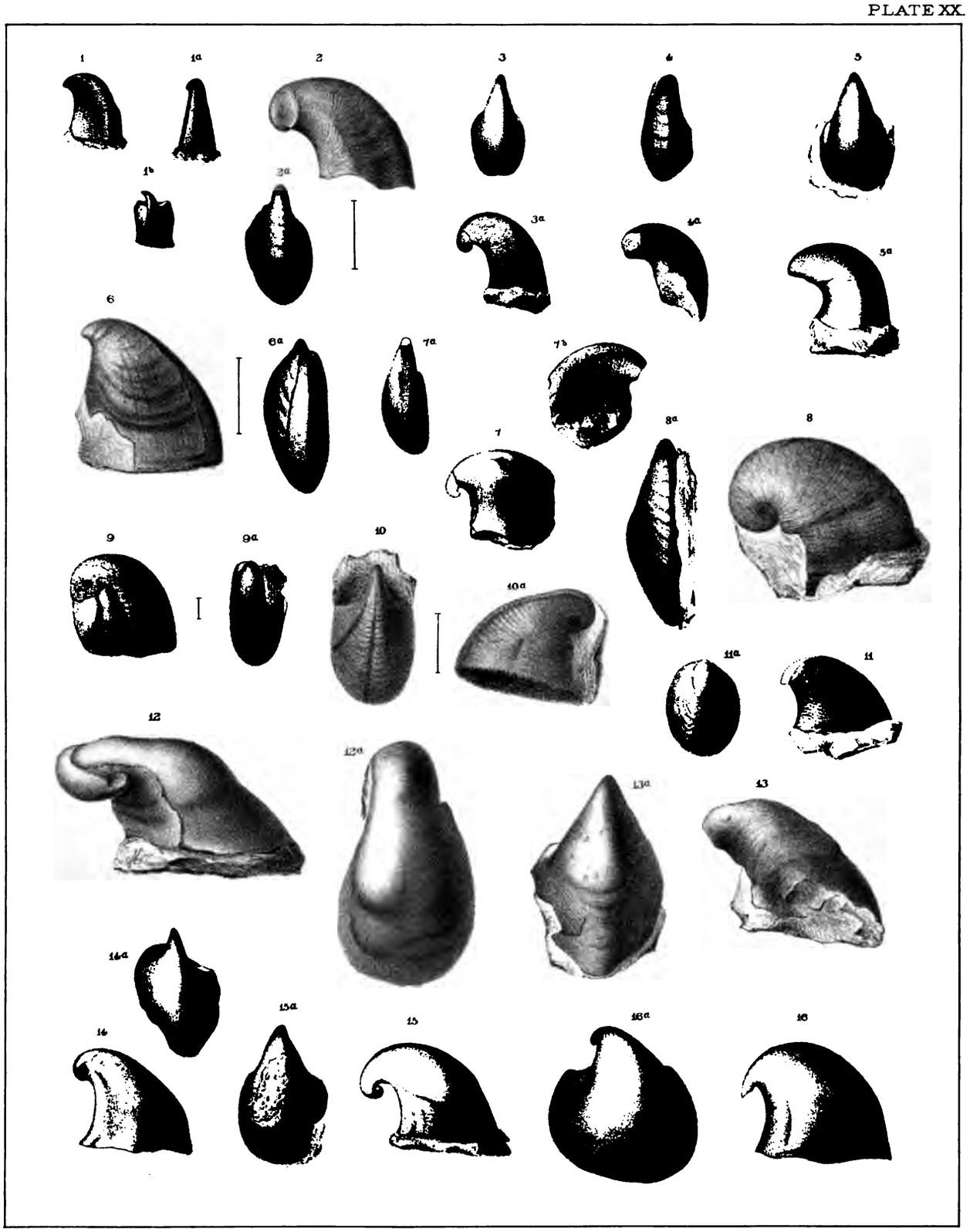

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PLATE XXI.

CAPULUS CORDATUS, *Whidborne*, sp. (Page 212.)

FIG.

1. Upper view of a specimen wanting shell; 1 *a*, apical view. Wolborough. Museum of Practical Geology.

CAPULUS USSHERI, n. sp.? (Page 213.)

2. Upper view of a specimen much obscured by matrix; 2 *a*, lateral view. Wolborough. Vicary Collection.

CAPULUS UNCINATUS, *F. A. Römer?* (Page 213.)

3. Upper view of a specimen; 3 *a*, apical view. Lummaton. Torquay Museum.

CAPULUS COLUMBINUS, *Whidborne*, sp. (Page 214.)

4. Upper view of a specimen, very defective round mouth, and partially denuded of the shell; 4 *a*, apical view, showing the contorted striation on the lower side; 4 *b*, portion of surface enlarged. Wolborough. Vicary Collection.
5. Upper view of a longer specimen, partially denuded of the shell; 5 *a*, apical view; 5 *b*, portion of surface enlarged. Lummaton. My Collection.

CAPULUS SQUAMOSUS, *Trenkner?* (Page 215.)

6. Upper view of a specimen wanting apex, and with a defective mouth, but showing the folding in of the upper part of the peristome; 6 *a*, lateral view; 6 *b*, portion of surface enlarged, showing in some degree the fine divaricating striæ. Lummaton. My Collection.

ORTHONYCHIA COSTATA, *Barrois.* (Page 222.)

7. Upper view of a specimen wanting apex; 7 *a*, apical view; 7 *b*, portion of surface near the apex enlarged. Lummaton. Champernowne Collection.

ORTHONYCHIA QUADRANGULARIS, n. sp. (Page 223.)

8. Upper view of a specimen wanting apex; 8 *a*, apical view; 8 *b*, portion of surface enlarged. Wolborough? Torquay Museum.

CAPULUS TYLOTUS, n. sp. (Page 216.)

9. Upper view of a specimen the surface of which has been injured by the removal of matrix, causing the appearance of a longitudinal ridge on the shoulder; 9 *a*, lateral view, showing tubercles. Lummaton. My Collection.
10. Lateral view of a specimen wanting the apical part; 10 *a*, portion of surface enlarged. Lummaton. My Collection.

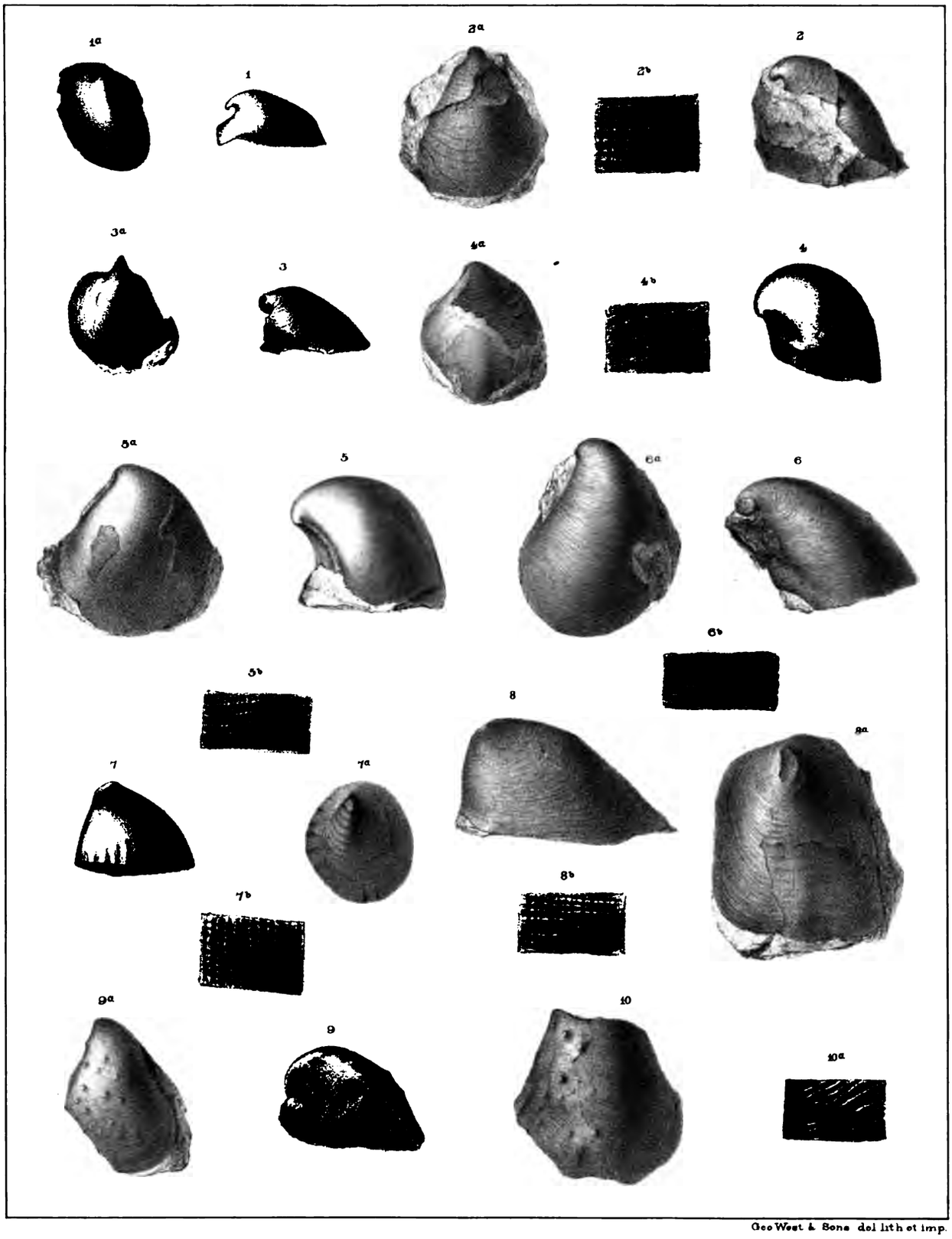

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PLATE XXII.

CAPULUS TYLOTUS, n. sp. (Page 216.)

FIG.

1. Upper view of a very small specimen, in which neither apex nor mouth is quite perfect, × 2; 1 *a*, apical view. Lummaton. Woodwardian Museum.
2. Upper view of a specimen whose shell is much injured, and which shows little or no signs of tubercles; 2 *a*, apical view; 2 *b*, portion of surface much enlarged. Lummaton. My Collection.

CAPULUS GALERITUS, n. sp. (Page 217.)

3. Upper view of a specimen wanting shell; 3 *a*, lateral view, in which the peristome is obscured by matrix. Wolborough. Museum of Practical Geology.
4. Apical view of another specimen, defective along lower side. Lummaton. My Collection.

CAPULUS CONTORTUS, *F. A. Römer?* (Page 218.)

5. Upper view of a very large specimen in which the outer layer of shell is absent; 5 *a*, lateral view; 5 *b*, portion of the surface of the thin inner layer of shell enlarged. Wolborough. Museum of Practical Geology.
6. Upper view of one of Phillips's figured specimens ('Pal. Foss.,' pl. xxxvi, fig. 169 *b*); 6 *a*, lateral view; 6 *b*, portion of surface enlarged. Wolborough. Museum of Practical Geology.
7. Upper view of a specimen with stronger ridges; 7 *a*, lateral view. Lummaton. My Collection.
8. Upper view of an aberrant specimen, showing deeply sinuous peristome and very irregular ridges. It comes very near Fig. 3 in general shape. 8 *a*, lateral view. Wolborough. Vicary Collection.
9. Upper view of a small specimen with very strong ridges, × 2; 9 *a*, apical view. Lummaton. Woodwardian Museum.

CAPULUS MULTIPLICATUS, *Giebel.* (Page 220.)

10. Upper view of a large specimen; 10 *a*, lateral view. Wolborough. Vicary Collection.
11. Apical view of a smaller specimen wanting apex; 11 *a*, lower view. Lummaton. My Collection.

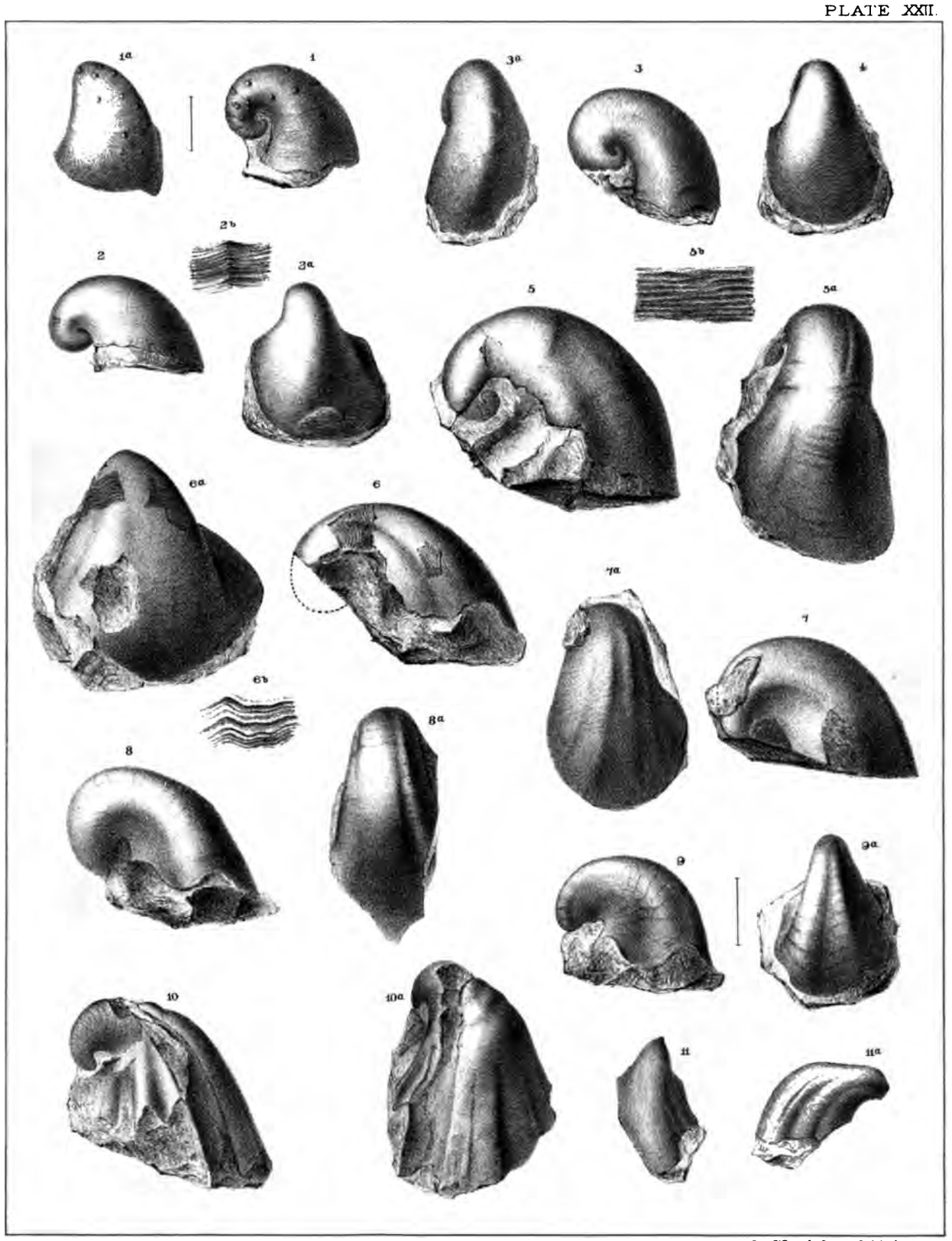

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PLATE XXIII.

PLATYOSTOMA ? DEFORME, *Sowerby*, sp. (Page 200.)

FIG.

1. Specimen retaining ornament, though not shown in the figure, defective from having been embedded in matrix; 1 *a*, apical view. Wolborough. Torquay Museum.
2. Small specimen. Wolborough. British Museum.
3. Another specimen, with injured surface and rather worn, but evidently having its spire composed of much less exposed whorls. Wolborough. Museum of Practical Geology.
4. Fine specimen, almost entirely free from matrix, but with decorticated surface, partially restored about the spire. There is a pinching in round the middle of the whorls, which it has been found impossible to represent in the drawing, × 2·5. Wolborough. Museum of Practical Geology.
5. Another specimen, retaining surface, but with defective spire, × 1·5; 5 *a*, portion of surface enlarged. Wolborough. Museum of Practical Geology.

PLATYOSTOMA SPECIOSUM, *Sowerby*, sp. (Page 202.)

6. Small specimen retaining shell, ×3; 6 *a*, apical view. Lummaton (?). Torquay Museum.

SCOLIOSTOMA TEXATUM, *Münster*, sp. (Page 231.)

7. Specimen showing the ornament and the aperture. Wolborough. Museum of Practical Geology. × 2·5.
8. Basal view of a specimen showing the twisting of the body-whorl and the ornament, though somewhat worn, × 2·5. Wolborough. Museum of Practical Geology.
9. Specimen wanting the surface, but showing the twisting of the body-whorl. Lummaton (?). Torquay Museum.

SCOLIOSTOMA GRACILE, *Sandberger* (?). (Page 233.)

10. Specimen with worn surface, × 2; 10 *a*, basal view, showing its defective mouth. Wolborough. Torquay Museum.

ANTITROCHUS ARIETINUS, n. sp. (Page 235.)

11. Specimen showing the ornament, × 2·5. Wolborough. Museum of Practical Geology.
12. Specimen showing aperture, though slightly defective, × 1·5. Wolborough. Museum of Practical Geology.
13. A wider specimen, in which the body-whorl has been broken and mended during the life of the animal so as to cause a deflexion in the ornament, × 2. Wolborough. Museum of Practical Geology.

PHILOXENE PHILOSOPHUS, *Whidborne*, sp. (Page 238.)

14. Specimen showing aperture. Chudleigh. Vicary Collection.
15. 15 *a*. Largest specimen known, showing the casts of agglutinated univalves and other shells. Chudleigh. Vicary Collection.
16. Specimen showing casts of agglutinations. Chudleigh. Vicary Collection.
17. Small specimen showing the cast of an agglutinated Brachiopod. Lummaton. My Collection.

PHILOXENE LÆVIS, *d'Archiac* and *de Verneuil*, sp. (Page 239.)

18. Apical view of a specimen bearing small scars from agglutinations; 18 *a*, side view. Wolborough. Museum of Practical Geology.
19. Small specimen with almost flat spire. Wolborough. Vicary Collection.

EUOMPHALUS DIONYSII, *Montfort*. (Page 244.)

20. Apical view of a small specimen; 20 *a*, side view. Lummaton. Woodwardian Museum.

PLATE XXIII.

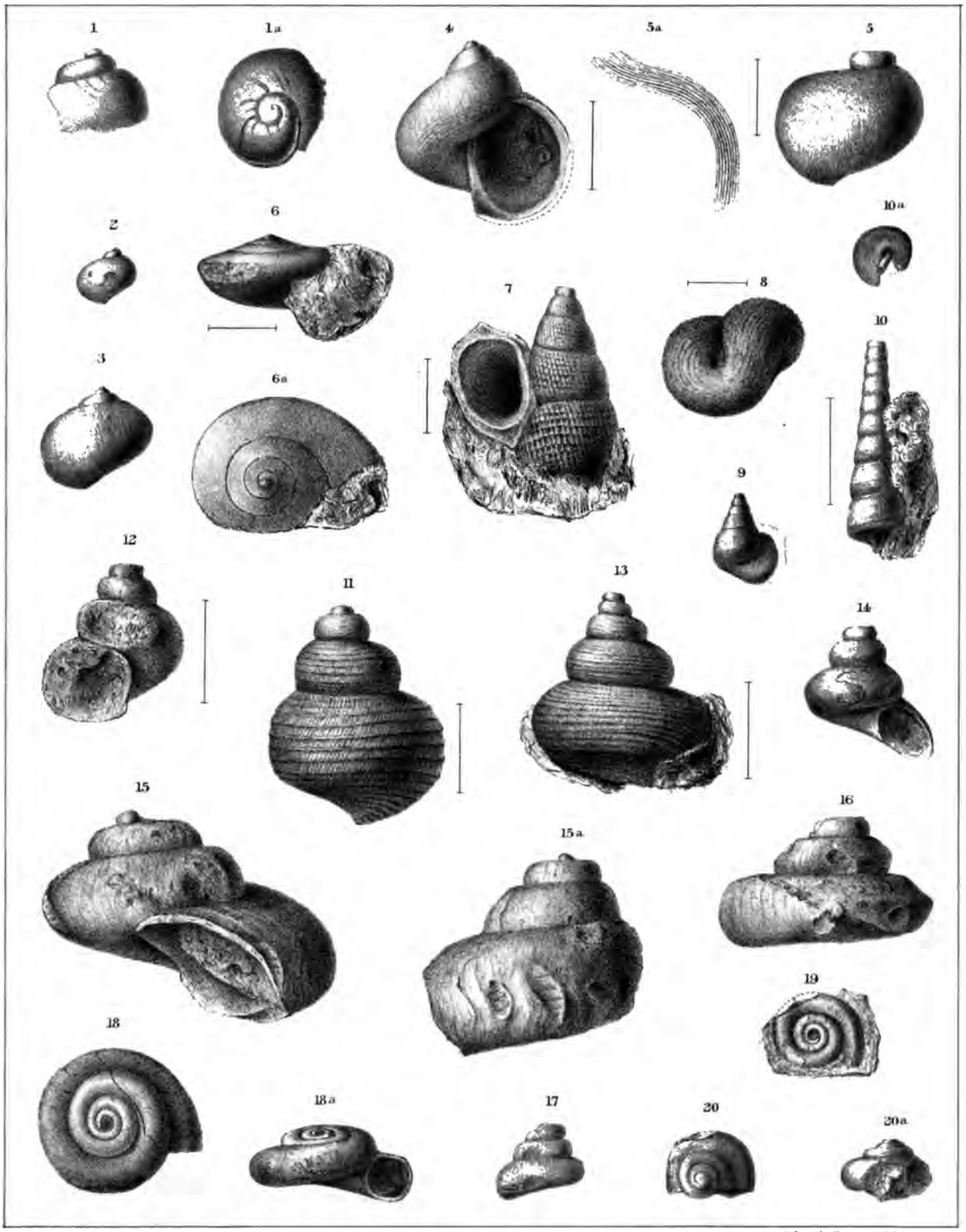

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PLATE XXIV.

PHILOXENE SERPENS, *Phillips*, sp. (Page 241.)

FIG.

1. Apical view of a specimen, showing numerous small scars of attachment, × 2; 1 *a*, side view. Lummaton (?). Torquay Museum.
2. Apical view of a specimen with worn surface, but showing signs of ornament, × 1·5; 2 *a*, side view. Wolborough. Vicary Collection.
3. Umbilical view of another specimen. Wolborough. Vicary Collection.
4. Apical view of a specimen with rather narrower and more numerous whorls; 4 *a*, side view. Lummaton. British Museum.
5. Defective specimen with very numerous apical whorls, × 4. Lummaton (?). Torquay Museum.

EUOMPHALUS ANNULATUS, *Phillips*. (Page 250.)

6. Phillips's type specimen, × 2. Wolborough. Museum of Practical Geology.

EUOMPHALUS HECALE, *Hall*. (Page 247.)

7. Apical view of a much-worn specimen; 7 *a*, side view. Wolborough. Museum of Practical Geology.
8. Apical view of a rather crushed specimen; 8 *a*, side view. Wolborough. Champernowne Collection.

EUOMPHALUS CIRCULARIS, *Phillips*. (Page 248.)

9. Apical view of a specimen with unusually angulated whorls; 9 *a*, side view. Wolborough. Vicary Collection.
10. Apical view of a specimen with very rounded whorls; 10 *a*, side view, with aperture much broken away. Wolborough. Vicary Collection.

EUOMPHALUS CIRCULARIS, *Phillips*, var. GEMMULIFER, nov. var. (Page 250.)

11. Apical view of a specimen with a very depressed spire and a nodulated keel-like ridge. Wolborough. British Museum.

EUOMPHALUS NEAPOLITANUS, n. sp. (Page 252.)

12. Specimen retaining the shell only on the apical whorls; 12 *a*, view of the apical whorls much enlarged. Wolborough. Vicary Collection.

EUOMPHALUS ARANEIFER, n. sp. (Page 253.)

13. Very defective specimen, × 3. Lummaton. My Collection.

PLATE XXIV.

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THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

LONDON:

MDCCCLXVI—MDCCCLXXII.

THE SUPPLEMENT

TO THE

BRITISH FOSSIL CORALS OF THE TERTIARY, CRETACEOUS, OOLITIC, AND LIASSIC FORMATIONS.

DIRECTIONS TO THE BINDER.

This Supplement will be found in the Volumes of the Palæontographical Society issued for the years 1865, 1866, 1867, 1868, 1869, and 1872.

Cancel the title-pages and table of contents given in the Volumes for the years 1866, 1867, 1868, 1869, and 1872, and substitute the accompanying title-pages and tables of contents, and place the sheets and plates in the order indicated below. The plates of the Tertiary Corals to follow their pages; the plates of the Cretaceous Corals to follow their pages; the plates of the Oolitic Corals to follow their pages, and the plates of the Liassic Corals to follow their pages.

ORDER OF BINDING AND DATES OF PUBLICATION.

PAGES	PLATES	ISSUED IN VOL. FOR YEAR	PUBLISHED
General Title-page	—	1890	April, 1891.
PART I, TERTIARY			
Title-page, Table of Contents	—	1865	December, 1866.
i—iii; 1—66	—	,,	,,
	I—X	,,	,,
PART II, CRETACEOUS			
Title-page, Table of Contents	—	1890	April, 1891.
1—26	I—IX	1868	February, 1869.
27—46	X—XV	1869	January, 1870.
PART III, OOLITIC			
Title-page, Table of Contents	—	1890	April, 1891.
1—24	I—VII	1872	October, 1872.
PART IV, LIASSIC			
Title-page, Table of Contents	—	1890	April, 1891.
i, ii, 1—43	I—XI	1866	June, 1867.
45—73	XII—XVII	1867	June, 1868.
Index to Tertiary Species			
Title-page, 3—6	—	1872	October, 1872.
Index to Secondary Species			
Title-page, 3—12	—	1872	October, 1872.

A MONOGRAPH

OF THE

BRITISH FOSSIL CORALS.

SECOND SERIES.

BY

P. MARTIN DUNCAN, M.B.Lond., F.R.S., F.G.S.,

PROFESSOR OF GEOLOGY TO, AND HONORARY FELLOW OF, KING'S COLLEGE, LONDON.

Being a Supplement to the

'Monograph of the British Fossil Corals,' by MM. Milne-Edwards *and* Jules Haime.

LONDON:

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

1866—1872.

PRINTED BY
ADLARD AND SON, BARTHOLOMEW CLOSE.

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PART II.

Corals from the White Chalk, the Upper Greensand, the Red Chalk of Hunstanton, the Upper Greensand of Haldon, the Gault, and the Lower Greensand.

Pages 1—46; Plates I—XV.

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PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.
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PART III.

Corals from the Oolitic Strata.

Pages 1—24; Plates I—VII.

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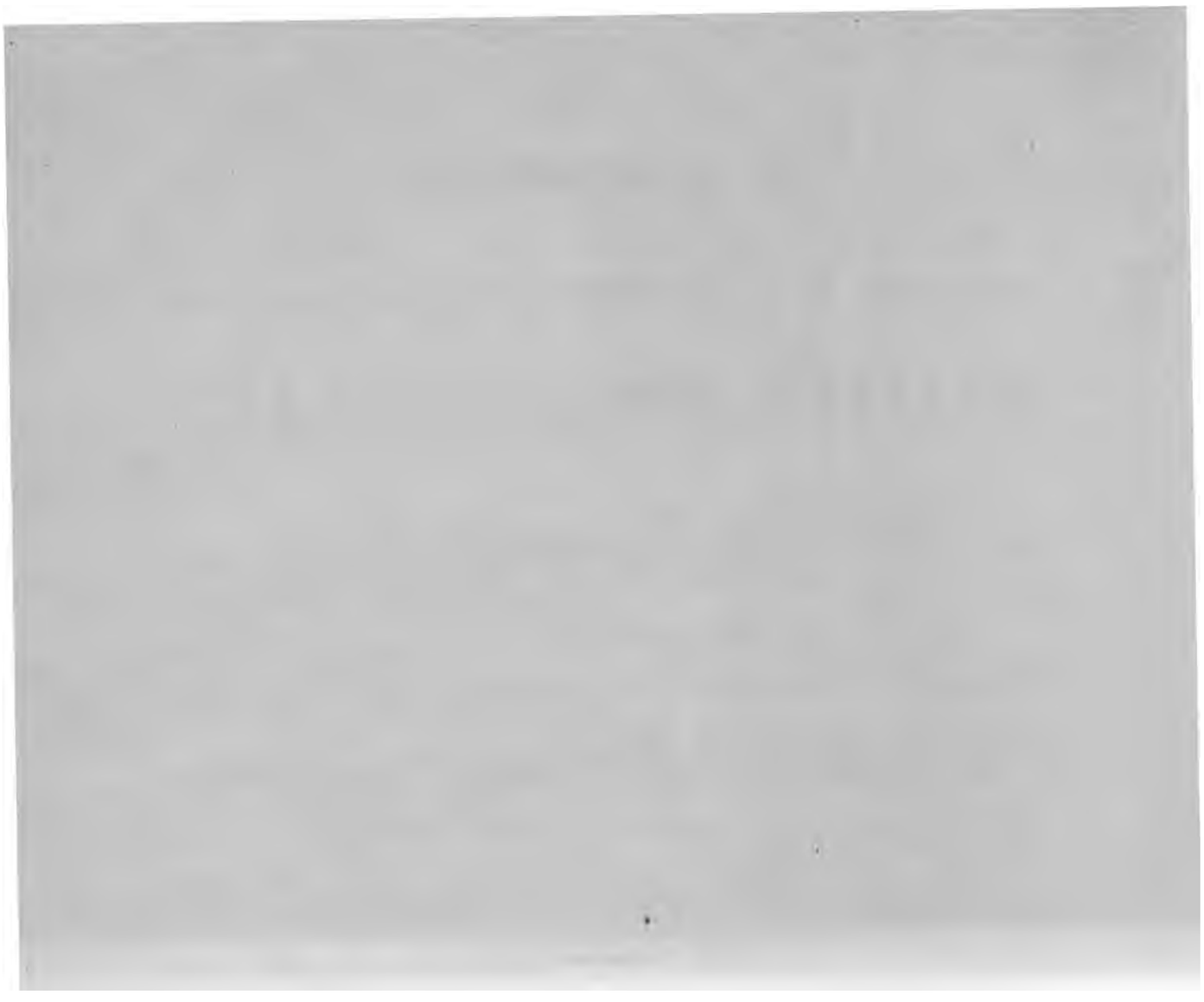

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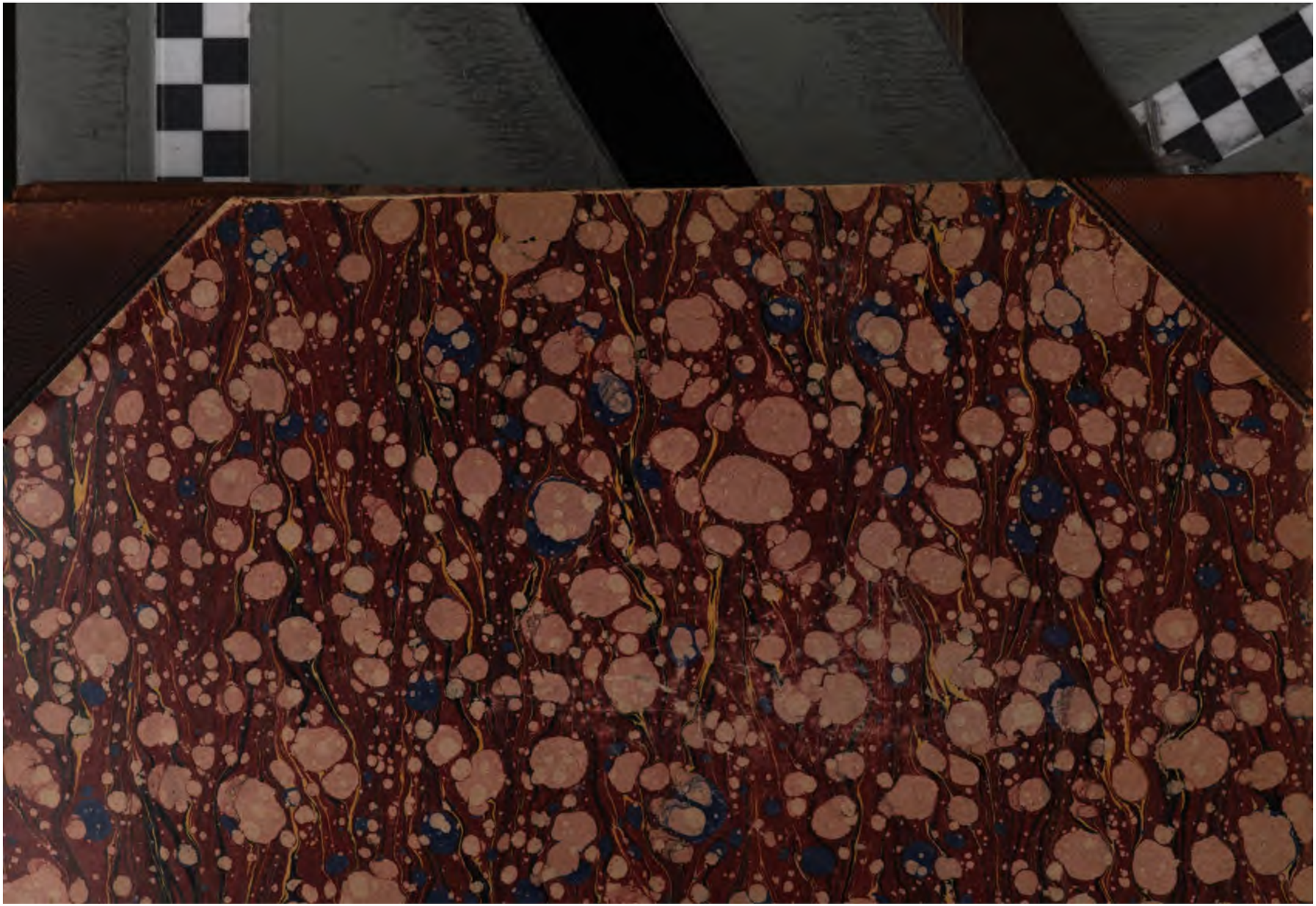
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